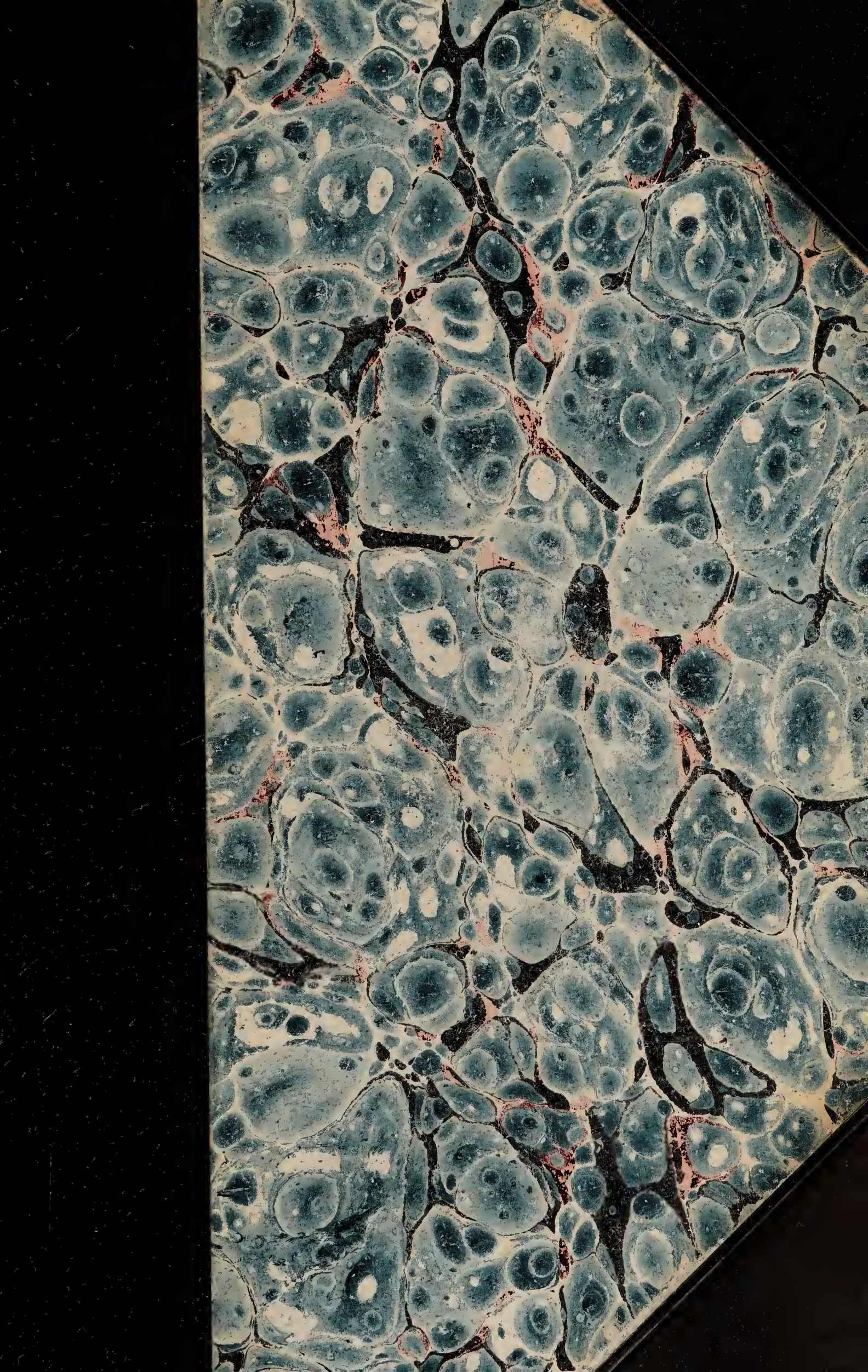




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W Birch
Dr. BOERHAAVE'S

Academical Lectures

ON THE

Theory of PHYSIC.

BEING

A GENUINE TRANSLATION of his

INSTITUTES

AND

EXPLANATORY COMMENT,

Collated and adjusted to each other, as they were
dictated to his STUDENTS at the University
of *Leyden*.

V O L. V.

Containing the Oeconomy of the Organs of Voci-
fication, and of Generation in both Sexes : With
general PATHOLOGY, concerning the Kinds
and Causes of Diseases.

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*Concerning the Voice, Speech, Singing,
Laughing, Coughing, Yawning, and
Sneezing.*

§. 626. **F**ROM what has been premised (§. 625.), we may clearly perceive the Manner of *Vocification*¹. For the Voice being a Sound formed in *Expiration*², does therefore proceed from an Expulsion of the Air contained in the Capacity of the Lungs, and discharged by those *Causes*³ which diminish or contract the Thorax (§. 619, 622.) through the *Wind-pipe*⁴ and its Bell-like Cavities; from whence it passes into the *Glottis*⁵, where the Passage being *narrower*⁶, and the Motion of the Air quicker, as it is forced upon elastic, tremulous, and resounding Cartilages, moved and regulated by the *recurrent Nerves*⁷ and proper Muscles, the Air is by that means struck into reciprocal Undulations, which produce Sound, as we are taught by mechanical *Philosophers*⁸.

¹ The Voice is distinguished either into Whispering, which by the conjunct Powers of the Organs is formed into Words hardly perceptible; or a clear Voice, arising from Sound produced in the Manner before described, but multiplied by the
B elastic

2 *Of the Voice, Speech, &c.* §. 626.

elastic Tremors of the hard Membrane or Dura Mater, which is spread over all the Bones and Ligaments. For thus are we taught by *Ammanus*, whom I judge to be the only Person that deserves to be consulted concerning this Subject. What has been said, may be demonstrated by an easy Experiment. If a Person, who is about to whisper, applies his Hand to his Head, and, as it were, whispers something to the Ear of his Friend, he will perceive his whole Cranium at Rest; whereas the same will be perceived to tremble, whenever he speaks with a clear Voice.

² A Voice may be also formed in the Act of Inspiration, as we see in those who speak in their Belly; but this Manner of Speaking is very rare.

³ Those Causes, namely, which compress the Lungs, and expel the Air, through the Wind-pipe (§. 622.).

⁴ The Air in its Course through the Wind-pipe excites no Sound, till approaching the Larynx, and expanding in the lateral Cells or Cavities, which are better described by *Morgagni*, than any other Anatomist, and being there repelled by the Resistance of the contracted arytaenoide Cartilages of the Glottis, the Collision excites Sound.

⁵ The Wind-pipe terminates in the Larynx, which has a wonderful Fabric, being made up of Cartilages of a particular Kind, elastic and very sonorous, connected to each other by tendinous Ligaments; for we here speak of the four Cartilages of the Glottis, the Epiglottis being properly not a Part of the Larynx concerned in Vocification, but rather an Appendix subservient to Deglutition. But tremulous Motions may be best promoted by elastic Ligaments, which, like musical Chords, being on all Sides fastened and stretched, yield a
beautiful

§. 626. *Of the Voice, Speech, &c.* 3

beautiful Resonance. It is also remarkable, that the Wind-pipe itself is a Cylinder imperfect on its back Part, the Cavity of the Larynx being much larger, especially if we include the two lateral Cavities. But this large Cavity of the Larynx terminates above in a slender Aperture or Slit, which in its natural State is extremely small, without being contracted. Through this Rima or Slit, the Air is expelled from the Lungs, and striking against the adjacent Parts, is again reflected by alternate Succussions; by which means the Air is put into quicker Tremors here than in any other Part; which Tremors are impressed upon the Cartilages, and returned again upon the Air by the Cartilages, by which means Sound is produced.

⁶ For the Air may be violently expired without producing any audible Sound, as long as the Glottis is not contracted.

⁷ But the Parts already mentioned, are not of themselves sufficient to form the Voice, unless the recurrent Nerves are in their natural State, so as to give a peculiar Tension to the vociferous Organs; for those Nerves being either tied or cut in Dogs, Pigs, &c. destroys the Voice, even though the Muscles endeavour to move the Larynx as before. *Ammannus*, who republished *Cælius Aurelianus*, observes, that the Voice is so animated by these Nerves, as to put on very different Changes: For you may whisper distinct Words into the Ear of an adjacent Friend, each of which he will understand without the Knowledge of any other By-standers. But the same Words may be sung with a loud Voice, so as to be understood at a great Distance; whence he concludes, that this loud canorous Voice results from a certain peculiar Influx of Spirits from the common Sensory, into every Part of the whole Body; for he had seen that all the

4 *Of the Voice, Speech, &c.* §. 627.

Bones in the Body trembled in a Person singing. We frequently observe in our Days, a Disorder in which the Voice is lost, when the Person endeavours to speak with a very loud Voice; but what should be the Cause of this Accident? Does it not proceed from some Compressure upon the recurrent Nerves?

* When the Air flows with a great Celerity against any tremulous elastic Body, Tremors or Waves are excited through the adjacent Atmosphere, and if these Waves follow each other with a sufficient Celerity, they produce Sound (§. 547. N^o 4.). Let a String be suspended in the open Air loosely, and it will yield no Sound; but let the String be stretched, and the Air striking against the String while it passes along in a Wind, will excite Sound, like what we observe when the Wind whistles through the Rigging of a Ship, making such a Noise, that the Sailors can hardly hear one another. In the same Manner the Air confined in, and expelled from, the Lungs, through the narrow Rima of the Glottis, by striking against its Sides, produces a tremulous Motion or Collision, from whence arises an obscure inarticulate Sound, containing nothing intelligible; we are therefore in the next Place to see by what Means the Voice is rendered distinct.

§. 627. But the Air or Sound thus *passing out*¹ through the narrow Rima of the Glottis into the membranous Cavities of the Nose and Mouth, is differently modulated or formed into various *Tones*², sent out through the Mouth, according as those Cavities are more open or contracted, more rough or smooth, or differently figured; and the Truth of this is de-

§. 627. *Of the Voice, Speech, &c.* 5
demonstrated from the Principles or Doctrine
of Sounds.

So soon as the Air passes through the narrow Rima of the Glottis, it consequently strikes against the whole Circumference of the Mouth, through which, and the Nostrils, it is protruded; for any Fluid, being compressed, expands every way in right Lines from the Point of Compression, as from a Center. The Air therefore strikes against the moveable Palate, where it again meets with a twofold Passage, through which the impelled Air may escape; for behind the moveable Palate, and before the Membranes spread upon the Bodies of the Vertebrae, there is an open Passage upward and outward to the Nostrils; and before the moveable Palate there is another Passage betwixt the Tongue and immoveable Palate to the Mouth; and in these Cavities does the Sound or Voice receive its Modulation. The Truth of this we may perceive in Singers, who increase or diminish the Sound, by altering the Configuration of the Parts through which the Tone is transmitted. What a considerable Share these Membranes have, may appear from the great Difference observable betwixt the Voice of a Person in Health, and of the same Person afflicted with a Cold or Catarrh, in which Case the *Schneiderian* Membrane is tumefied, and the Antra of the Nose obstructed; for when a Person speaks through the Mouth only, the Voice becomes rough and confused, whence appears the Impropriety of the popular Phrase by which this is denominated speaking through the Nose. A different Configuration therefore of these Parts always produces a Difference in the Voice. Thus from an Erosion of the moveable Palate by a venereal Ulcer, the Voice becomes rough or disagreeable, which yet may be corrected by shutting

6 *Of the Voice, Speech, &c.* §. 628.

the Nostrils in speaking; the Benefit of which I observed in an extraordinary Case of this Nature, in a certain Person of Distinction.

² *Ammannus*, in curing the Deaf and Dumb, who had been so from their Birth, easily taught them to expire, but found it more difficult to teach them to expire the Air so as to yield an audible Sound; nor could he surmount this Difficulty but by causing the Patient to lay his Hand upon his Larynx while he spake, that he might perceive the Tremor of the Parts.

§. 628. But since the cartilaginous *Sides* ¹ of the Larynx, termed the arytaenoide Cartilages, are connected by their Sinuses to the small and smooth Heads of the cricoide Cartilage, and being lubricated with an unctuous Liniment of their own, they form a small Rima or Slit, by their Connection capable of dilating or *contracting* ², according to the various Actions of the several Muscles moving those Cartilages (§. 194.); from hence arises the Difference of Acuteness and Gravity in the Voice, which result from a more *quick* or *slow* ³ Repercussion of the undulating Air; for the Vibrations become quicker, as the Rima of the Glottis is more contracted, and causes the expelled Air to pass through with a greater Velocity, whence a shrill Voice; and, on the contrary, the Rima or Aperture of the Glottis being enlarged or dilated, the Undulations of the Air become more slow, and produce a more grave Voice, as the Air is expelled more slowly; the Truth of which is demonstrated to us by *Musicians* ⁴.

§. 628. *Of the Voice, Speech, &c.* 7

¹ The arytaenoide Cartilages are two in Number, and are connected to the annular Cartilage by Enarthrosis: They are also provided with Muscles, by which the Rima of the Glottis may be contracted or reduced to nothing, and dilated to a very great Breadth. When the Rima of the Glottis is largest, the Cartilages recede near Half an Inch from each other; whence it follows, that from close Contact, the Glottis may be dilated through almost an infinite Number of Degrees, to the Breadth of the middle Finger.

² It is well known, and observed by the Ancients, that the human Voice is either shrill and puerile, or grave and masculine; but most People who have these Organs well conditioned, are capable of raising and depressing the Voice through successive Degrees, for the Compass of an Octave and a Half from the most grave, to the most acute Tone, which they are able to exhibit; but if they endeavour to exceed those Limits, their Breath fails them. If they endeavour to descend lower to produce a more grave Tone, their Voice ceases, because they dilate the Glottis so far, that it becomes equal in Capacity to the Wind-pipe, whence the Air passes through it without any Collision or Vibration; and, on the contrary, if they endeavour to exhibit a more acute Tone by a too close Approximation of the Glottis, their Voice becomes squeaking, and deserts them. These different Tones which fall within the Compass of the Voice, are by Musicians distinguished with various Titles, the more grave being termed Bass, and the more acute are said to be in Alt. But all this Difference in Tone proceeds from a different Capacity, or more or less Enlargements of the Rima of the Glottis. Let the Rima of the Glottis which is intercepted betwixt the arytaenoide Cartilages,

8 *Of the Voice, Speech, &c.* §. 628.

be dilated to a certain Degree; if the Person then expires with a certain Force, while other Things continue in their natural State, there will be always some Tone produced, which in every Person has almost a different and determinate Degree of Acuteness or Gravity: But now let the same Person approximate the arytænoide Cartilages as near again to each other, so as to contract the Rima of the Glottis to Half its former Dimensions; in that Case the Voice will be yielded a whole Octave more acute, and will become still more acute, as those Cartilages approach nearer to each other, and diminish the Rima of the Glottis. But the different Degrees of this Approximation of the arytænoide Cartilages, are almost innumerable in Men, and other canorous Animals. The Nightingale has its Glottis so variable, that M. *Dodart* has reckoned up six Thousand intermediate Degrees, betwixt the highest and the lowest; and even from a most accurate Calculation he deduces the Changes of the Glottis productive of different audible Sounds to be 7632 (*Mem. Acad. Ann.* 1700. p. 359.). So that this Difference of Change in the Capacity of the Rima, producing a different Tone, he finds, will not exceed the $\frac{1}{378}$ th Part of a Hair of one's Head. From hence proceeds that surprising Divisibility of Semitones into eight Kinds of Time or Succession, which expert Musicians are able to put in Practice. If, again, the arytænoide Cartilages are successively removed farther from each other, the Voice will fall from a more acute to a more grave Tone, at every the least Degree of Dilatation in the Glottis.

³ But it is not the Capacity of the Rima only which alters the Sound: For if the Glottis retains the same Aperture, and the Breath is forced out
with

§. 628. *Of the Voice, Speech, &c.* 9

with twice the Celerity, the Voice will, by that means, become proportionably more acute; since Musicians teach us, that a Pipe, which yields a certain Tone by gentle blowing into it, will yield a Tone an Octave higher, or more acute, by a more strong Inflation of the Air. There is therefore a twofold Cause of Acuteness in the Voice; namely, 1. A Diminution or Contraction of the Rima of the Glottis. 2. A more swift or strong Expulsion of the Air: For if these two Causes are conjoined, the Tone of the Voice will be still more acute. It is remarkable, that Men who are solicitous in pleading for their Life, speak with an acute complaining Voice; and also, that the Voice becomes more puerile and shrill, as a Person is more enraged with Anger: So that a Man, who naturally speaks with a very grave or bass Voice, speaks with a quite effeminate Tone, when extraordinarily enraged. The Cause of this Phænomenon is a more swift Expulsion of the Air through the Glottis; and at the same Time we observe, that the Eyes and Cheeks look red, while Efforts are made to contract the Glottis. It is well known, that the Velocity of Fluids running through Apertures, is as the Square of the Lights of those Apertures compared with each other; and therefore when the Air is blowed out more strongly through the more closely contracted Glottis, it will be retained in, and distend the Lungs, whose Blood-vessels will be thus compressed, so as to hinder that Fluid from passing through the Lungs to the left from the right Ventricle of the Heart; into which last, therefore, the Blood cannot descend from the Head through the jugular Veins and superior Cava; whence the forementioned Redness of the Face and Eyes.

* Singers who have the Faculty of accurately contracting the Glottis from its greatest to its least Dilatation, and who know how to retain it in that Position, are the only Persons to be valued upon that Account; and there is not one in a Thousand born with a natural Disposition to become excellent Singers; but a Person as before mentioned will yield a constant or uniform and clear Voice, uninterrupted with Tremors. This Faculty depends upon the Muscles which contract and dilate the Space intercepted by the arytænoide Cartilages, which ought therefore to act very distinctly, and continue in that Action unalterable during the necessary Periods; and thus the Air will pass out of the Lungs, so as to be accelerated or retarded in any Degree required, or so as to pass no swifter in one Moment of Time than in another.

§. 629. From hence it appears, that when this Rima of the Glottis is too much dilated by those who endeavour to yield a more *grave Tone*¹ than falls within the Compass of their Voice, it immediately fails them, or the Sound is lost; and that the same also happens when they endeavour to exhibit a too sharp or *shrill*² Voice, the Air retained in the Lungs causing a Sort of Suffocation, and a squeaking Noise in the Larynx.

¹ When a Boy endeavours to speak with a Man's Voice, the Glottis is so violently dilated by its three Muscles, that the Rima becomes as large as possible; but then the Air only escapes without yielding its due Tone, because the Glottis is rendered equally capacious with the Wind-pipe, so that the Air passes out slowly, and without Collision;

§. 629. *Of the Voice, Speech, &c.* II

lision; nor is the Voice framed audible as it ought to be when we suddenly expel the Air all at once by too great a Dilatation of the Glottis, as in yawning. The Course of the Air being resisted produces Sound; but remove the Resistance, and you destroy the Sound.

² When an adult Person endeavours to yield a more acute Voice than he is naturally capacitated for, we observe that his Voice fails him, his Eyes and Face look red, and run down with Water; and, if he obstinately persists in urging his Voice, either faints away, or becomes apoplectic. Nothing injures or weakens the Bodies of those who sing in Concert, so much as striving to exhibit or raise their Voice too high, to keep equal with the Harpsichord or Organ; for then they are obliged to contract the Glottis to a very great Degree, and to expel the Air with a great Force: But the Air cannot but pass through the Glottis in a less Quantity, as its Rima is more contracted; and hence the Air violently compressed will be repelled by the narrow Rima of the Glottis, as that is more contracted, and the Voice rendered more acute. Hence the Lungs will be pressed against the Pleura, the Blood will be pressed out of the pulmonary Veins, and at the same Time the Arteries will be so compressed as to admit no Blood; and thus the Strength of the Body will continue as long as the Blood is expelled by the left Ventricle of the Heart, but will fail soon after, when the same Ventricle receives no Blood; whence a Deliquium or Fainting ensues, because the jugular Veins cannot empty their Blood into the right Ventricle, which itself cannot overcome the Resistance given to the pulmonary Arteries by the confined Air: Thus the Brain will be compressed by the arterial Blood, so as to be in Danger of an Apo-

Apoplexy from the Rupture of an Artery. But a squeaking Noise is yielded instead of a distinct Voice in this Case. because the Aperture of the Glottis is contracted beyond its natural Diameter, in Proportion to that of the Wind-pipe : For Organ-Builders know, that there is a certain Proportion betwixt the Diameter and Mouth of any Pipe, which will enable it to yield the most harmonical Tone ; which Proportion, being exceeded, will render the same more or less disagreeable to the Ear.

§. 630. If this *Sound* ¹ strikes against the Organs placed without the Larynx (as the Throat, Tongue, Teeth, Lips, Nostrils, Cheeks, Palate fixed and moveable, with the various Action of the Muscles), the Sound is, by that means, altered in its Passage, and variously reflected, so as to express the several Sounds which we intend by the *Letters* ² ; concerning the Origin and Combination of which, so as to form a Speech, the only Person to be consulted is *Johannes Conradus Ammannus*, a Man of happy Success and surprising Industry in these Matters.

¹ That is, the natural Voice in common to Mankind suffers a Modulation, so as to be formed into Letters which compose Speech. The *Hebrews* call this Sound the Voice, and do not write the Vowels, nor reckon them as Letters, expressing only those which we call Consonants with proper Characters ; and hence it is believed, that the most ancient Languages, the *Phœnician*, *Chaldean*, and *Hebrew*, made Use of no Vowels,

² A Vowel is therefore a certain Modulation of the human Voice, of which there are commonly reckoned Five; but *Ammannus* demonstrates them infinite in Number, and proves that the *English* A differs from the *Helvetic*, the *Helvetic* from the *German*, and the *German* from the *Dutch*; and that even different Tribes of the same People speak differently: That the People of *Leyden* pronounce the A different from those of the *Hague*, and these again different from those of *Amsterdam*: So that all these Sounds, signified by the Character A, are specifically different from each other. Most People likewise make Diphthongs by compounding the Vowels; whereas these are, in Reality, different Sounds; and even the Letter E in one Word and another differs not only in Length, but also makes very different Sounds. These Observations have been traced by *Ammannus* through most of the living and dead Languages; and, if he had lived, would have determined the Pronunciation of all Letters, and fixed them to invariable Laws, assigning also the Notes or Voices of Brutes, and representing the State of the Organs with which each are formed; but we have been deprived of this useful Work by his premature Death. The Consonants are sounded almost alike in every Language. These Letters of themselves produce no Sound, without being joined with some Vowel, and yet have the Vowels no Relation in common to the Consonants. A Person, without observing this, would teach a deaf Man to speak Pater Pe--a--te--e--er; but *Ammannus* avoided this Inconvenience, by teaching his Scholars to have distinct Ideas of each Consonant, without mixing them with any Ideas of the Vowels. The Consonants are of two Kinds; some being pronounced by a mere Aspiration, which makes them different from those without an
 Af-

Aspiration; thus *a* joined with an Aspiration becomes *b*. This Aspiration or Accent, is generally omitted, but improperly betwixt Consonants; nor would it produce any Sound without being joined with a Vowel. Another Class of Consonants are those pronounced by the moveable Velum of the Palate, Cavity of the Nose, with the Tongue, Teeth, and Lips; hence the *Hebrews* rightly distinguish their Consonants into Guttural, Palatine, Dental, Labial, and Nasal; and, by this means, *Wallis* and *Ammannus* have taught the whole Alphabet to be formed. But Speech we call the Determination of Vowels, by prefixing or subjoining Consonants. Thus, for Example, *to* and *a* may be pronounced almost in any Position of the Mouth; but in pronouncing *ba*, the *a* is not pronounced alone, but joined with the *b* by closing the Lips, together with a certain Position of the Tongue; the *a* sounding nothing of itself, but with the Addition of *b* sounds *ba*. This being understood, we may be able to teach deaf People, who never had any Idea of Sound, to pronounce articulate Sounds. Thus *Ammannus* placed himself before a deaf Person, speaking slowly and distinctly, directing his Scholar to look attentively upon his Mouth; and thus, by Imitation, the deaf Man could, by a like Disposition of the Organs of Speech, and blowing out of his Breath, pronounce the same Words which he had observed in his Master. *Ammannus* thus taught a deaf Lad, who is now living, so to hear with his Eyes, that he could take down in Writing a whole Sermon from the Mouth of the Preacher, and afterwards read it over at Home with a distinct Voice. Speech is therefore the Pronunciation of Words, according to the Dictates of a Master, or of Custom only, by which Things are commonly de-

§. 630. *Of the Voice, Speech, &c.* 15

denoted in each particular Nation. The whole Business of Speech, then, depends upon a certain Disposition of the Organs, with a determinate Expiration of the Breath; and a Man is said to speak with an articulate Voice, when the Organs are disposed in a determinate Manner, while the Breath is, in like Manner, blowed out. If now, by our intellectual Organs, we conjoin certain written Characters together with those articulated Sounds, those Characters being expressive of another's Words, we then read, or perceive the same Ideas as if we heard him speaking; and thus may a deaf Person be taught, even though he be ignorant of what he is about. But there are various Faults in the Speech of different People: Some stutter, others speak with a squeaking, or broken Voice, and many are defective in the Pronunciation of particular Letters, while others, again, have a Lispering; all which Faults may be corrected. Thus *Ammannus* has cured several that have stuttered and lisped, &c. so as to render them capable of speaking distinctly within the Space of two or three Hours, only by demonstrating to them the different Manner in which their Tongue ought to be disposed. Thus *Demosthenes*, the Grecian Parent of Eloquence, cured a Defect in himself, as we are told by *Plutarch*; for he hesitated at the Letter *r*, the Initial of Rhetoric which he professed; and therefore he betook himself to Solitude, and by laying Stones upon the Back of his Tongue, depressed the same, so that it could not tremble in duly pronouncing the *r*. A like Method of Cure was used by *Ammannus* in a certain Person of Distinction, who pronounced the Letter *d*, instead of *k*, so that he called *Cæsar Deiser*; but this Person was taught by *Ammannus*, in the Twinkling of an Eye, to pronounce the Letter *k*, by directing him

him to depress his Tongue a little more. Another Specimen he gave of his Art, in a Relation of an *English* Orator, who was sent Ambassador to the *States*, and dwelt at the *Hague*; this Lady pronounced many Words improperly, and it was objected, that she could not learn to pronounce of a Master, who knew not how to speak *English*. The Ambassador, therefore, was desired by *Ammannus* to pronounce those difficult Letters, which his Kinswoman was to learn, and by attending diligently to the Ambassador in his Pronunciation, he, by his Sight, learned the muscular Motions, by which those Letters were formed, and, by that means, he corrected the Lady's Speech, by directing her to imitate the same Motions.

§. 631. But since *Singing* ¹ is the Utterance of Sounds, either acute or grave, quick or slow, strongly or softly, equable or inflected; therefore that Action may be understood from what has been already premised, the Excellencies thereof depending upon the *Voice* ², Degrees of Tone, Time, and turning or changing.

¹ There are two Kinds of Singing, in one of which the Words are pronounced, which is peculiar to Man; and the other is without Words; and both these are again distinguished into *Arietas* and *Recitativos*, the former of which is adapted to Descant and Dancing, the other to Words which may be distinctly understood. These Kinds were well known to the Ancients, as we learn from *Plutarch*, who writes concerning *Gracchus*, that when he stirred up the common People, daily, by his most eloquent Orations, he often raised his

his Voice so as to render it feminine, till it even failed him, and therefore he had a Servant hard by, with a Pipe, sounding those Notes which his Master was to give, or to which the Oration was to be modulated. The *Italians* use this Kind of Singing in their Operas, in which intelligible Words are to be pronounced. From this Kind of Singing it is, that some Men speak very pleasantly, and others uncouthly: For all Orators, who would be understood at a Distance, are, in a Manner, obliged to sing. Some People sing very agreeably, though their common Discourse is harsh enough, and the Reverse. But the other Kind of Singing is performed by the Voice only; for we may sing over a Tune by modulating, elevating, and depressing the Voice, without pronouncing Letters.

² There are many Musicians who, on Account of their Voice, do not please, tho' they sing with the greatest Artifice; and there are others who draw the Audience into Admiration, when they hardly pronounce a Letter.

§. 632. A smooth and lubricated Surface in the Organs, together with a due Conformation of the Throat, Mouth, Palate, and Nose, contribute to the Sweetness of the Voice, which resulting from the natural Condition of the Parts, cannot be improved by Art.

§. 633. *Agility* ¹ of the Muscles serving to move the Glottis, a Laxity or Pliability of the *Ligaments* ² connecting the Cartilages of the Larynx, with the different *Magnitude* ³ and Shape of the Glottis and its Rima, assisted with a Quantity of oily *Juice* ⁴ expressed from

C

the

the thyroide Glands, chiefly by the incumbent sternohyoide and sternothyroide Muscles, seem each to conduce towards a ready, distinct, and clear Formation of various Sounds or Tones.

¹ The greatest Part of Perfection in Singing consists in the Activity of the Muscles which dilate and contract the Glottis, acting swiftly, and holding out for a long Time; upon both which depends that which is so pleasing to the Ear of a skilful Musician. For when we read *Kircher* concerning the most excellent Singers at *Rome*, we find, that they could not only distinguish Semitones, but they could also divide them into several Parts, and again distinguish or distinctly sound those Parts divided into more minute Points or Tones, sounding as many Notes or Divisions as the Nightingale.

² This Pliability of the Ligaments conduces much towards an Agreeableness of the Voice; more especially if they are not only pliable, but in a certain harmonical Degree of Tension.

³ That is to say, if the Glottis can be very much dilated on the one Hand, and very much contracted on the other. I was surpris'd at this Faculty in a certain *Dutchman* of *Gueldre*, who very distinctly ascended and descended through fifty-six Tones.

⁴ Inasmuch that only one Drop of the Mucus being dried up by the Air may render the Voice disagreeable, and therefore that Drop is to be again supplied. *Isabella*, who was the Delight of the Court of the Duke of *Mantua*, and hired at a most immense Price by the Rich to sing in the Operas, used after singing to discharge a Spoonful

§. 635. *Of the Voice, Speech, &c.* 19

or two of a thick Mucus of a frightful Aspect; after which she was not able to sing one Line more, nor did her Voice recover itself so as to sing again under two or three Days Rest.

§. 634. The Structure of the Lungs and Thorax which *supply Air*¹, seem to be the chief Cause of the Strength and Length of the Voice; but the Art of singing well, depends on a particular turning and moving of all these Parts before enumerated.

¹ In such a Manner, that the whole Lungs may be evacuated by blowing out their Air equally and slowly, without being obliged to take in more by a new Inspiration.

§. 635. *Laughter*¹ is produced by a Dilation of the Lungs and Reception of the *Air*² into them, which is, as it were, agitated with an undulatory Motion in the Lungs and Wind-pipe without being renewed, but continues *shook*³ with very quick, small, and reciprocal Concussions made by the Organs of Inspiration and Expiration; in the mean Time the Lungs continuing almost in the same Degree of Extension, do in this Action rather shake the Blood, than transmit the same thro' its Vessels. From hence we know why Laughter is so *fatiguing*⁴, that it may often terminate in Convulsions? How it comes to produce such a considerable Swelling of the jugular Veins, and consequently of the whole Head? Why, at the same Time, the Face, Neck,

and Eyes look red; and how, if it be too long continued, it sometimes produces a Loss of Breath, a spitting of Blood from the Lungs, or even an Apoplexy, and Death? And why, on the contrary, it so much conduces to Health when *moderately* ⁵ exercised?

¹ *Aristotle* writes, that no Animal laughs besides Man; and that therefore Laughter is one of the Attributes proper to Man. But there are two Sorts of Laughter; one with a manifest Noise, and the other without; but, in other Respects, they are alike.

² When a Person is about to laugh, as much Air is inspired as they well can, which Air is agitated by a tremulous Motion of the Diaphragm, with the intercostal and abdominal Muscles, so as to undergo repeated Concussions whilst it is included in the Air-Vessels of the Lungs, which receive no fresh Air, and discharge little of that which they retain.

³ So that the Blood is shook and rarefied, so as to become frothy, without being transmitted thro' the proper Vessels.

⁴ Among all the Actions of human Life, there are none which so much exhaust the Strength as that of Laughter. Of this we have an Instance of old in a *Greek* Comedian, who having invited his Friends to Supper, by Accident, the Figs left in an open Window to be presented to the Guests, were eaten up by an Afs which passed by; the Comedian afterwards enquiring for the Figs, demanded whither they were gone to; to which the Servant replied, that they were taken and devoured by the Afs. If so, says the Comedian, let some Wine be given to the Afs, for after
Figs

Figs it is proper to drink: But while he was speaking this, and reflecting upon his own Wit, he fell into such a violent Fit of Laughter, that he expired. I once saw a Man taken with such a violent Fit of Laughter at Dinner, that he at length fell down senseless upon the Floor, every one present believing he would expire of an Apoplexy; so much were the Veins of his Head and Neck swelled, his Eyes extremely red, turgid, inflamed, and running down with Tears, his Face being quite of a Purple, that he could not have long survived in that Station, if proper Assistance had not been given him. These Consequences follow, because, in profuse Laughter, the right Ventricle of the Heart cannot discharge its Blood, and therefore the jugular Veins are not permitted to discharge that which they contain, so that thus no Blood can pass, either to the left Ventricle or to the Brain. But an Artery has hence been frequently known to be burst in the Brain, which immediately produces an Apoplexy; or else some of the pulmonary Vessels being burst, has produced an Hæmoptoe, or being obstructed, a Peripneumony has followed. It is also certain, that a Fit of Laughter will suddenly take down a Tentigo Venerea, by drawing the venal Blood upwards.

5 The ancient *Greeks* judged nothing more conducive to Health than Laughter; for which Purpose they studiously cultivated Comedies, to recreate the Citizens, overwhelmed with Business, by publick and unexpensive Diversions. But even some of the most eminent Physicians have cured Melancholy and leucophlegmatic Disorders, by exciting moderate Laughter; for, by that means, the Blood is pressed in a greater Quantity to the left Ventricle of the Heart, from whence it is sent in a greater Quantity to the Brain, which

therefore secerns the Spirits more plentifully. But then this Laughter ought to terminate before the jugular Veins become turgid, to prevent worse Consequences.

§. 636. From what has been premised, the Nature of Coughing is sufficiently evident, since that is performed by drawing a great Quantity of Air into the Lungs, where being a little *confined*¹, it is soon after *condensed*² by the forcible Protrusion of the Diaphragm and abdominal Muscles up towards the Thorax, while the Larynx is closed; which last being again suddenly opened, the Air is forcibly expired by reciprocal Concussions, by which the Sides of the Bronchia are deterged. Hence we may perceive, why *Laughing*³ often terminates in Coughing? and what a small *Difference*⁴ there is betwixt those two Actions? Why strong Singing, or calling out aloud, all *rough*⁵ Things, and the *Nakedness*⁶ of the Membranes of the Bronchia, occasion it.

¹ This appears from the violent Sound that accompanies Coughing.

² The Air inspired in a large Quantity, and retained some small Time in the Lungs, being there rarified, compresses the Sides of the pulmonary Air-Vessels, and then, by the Consent of all the expirative Muscles, the rarified Air is suddenly exploded through, and forced along the Sides of, those Air-Vessels, so as to wipe off what adheres to their Sides; whence this Action appears to be truly a cleansing of the aerial System of the Lungs. This Action is followed with a more copious
Flux

Flux of Mucus to the Parts. I distinguish three Kinds of Coughing: The first, being seated the lowest, is that which we observe in a Phthisis, Hæmoptoé, or Peripneumony, being always of bad Presage; the second Kind is that which only cleanses the Bronchia, and renders the Voice more clear; the third and last is that excited in the upper Parts of the Larynx, by the Irritation of any Liquor slipping aside in Deglutition, or from the natural Mucus redundant in a Cold.

³ Namely, because in this Action the Mucus of the Trachea is forcibly abraded, whence the Nerves are exposed to the Action of the reffluent Air, which they are not capable of sustaining without Irritation, unless defended by their Mucus, whereupon follows an irresistible Inclination to Coughing.

⁴ There is but little Difference betwixt Laughing and Coughing, except what we observe in the Face during the former, while the Air is expelled by more swift Concussions through the more contracted Rima of the Glottis, to which add their proceeding from different Causes.

⁵ Coughing arises from every Thing poisonous or inimical to the Lungs, by which means the defending Mucus is expressed to cover and defend the Wind-pipe, and catch or infringe the offending Acrimony; which being discharged, together with a thick Mucus, by Spitting, the Cough then ceases.

⁶ This tickling Cough, arising without any manifest Cause, is generally fatal, terminating at last in a Consumption, from a Rupture or Solution of Continuity in the Lungs. This convulsive Cough ought therefore to be mitigated in the Beginning by a prudent Use of Opiates, which suppresses the Motion or Irritation of the Nerves;

24 *Of the Voice, Speech, &c.* §. 637.

but the same Remedies will be prejudicial in a phlegmatic Cough, in which there is a considerable Evacuation; and therefore it is very necessary to distinguish these two Species of Coughs in Practice.

§. 637. *Sneezing*^r, which we explained before at §. 498. may be likewise *clearly*^r understood from what has been here said, since it differs but little from Coughing, the Air being only expelled with a greater convulsive Force of the Muscles at once through the Nose instead of the Mouth.

^r Sneezing follows when the Air has been inspired in a large Quantity, and retained a good while, so that the Person who is about to sneeze, remains for some Time in Suspense, doubtful whether he shall expel the confined Air. Thus the Lungs are dilated by the retained and confined Air, while the Glottis is closed, and then a convulsive Expiration follows from a Contraction of all the Muscles moving the Thorax, whence the Air is expelled with a great Force and Noise through the Larynx, by which it is determined upward, and chiefly through the Nose; thus the whole Organ of Smelling is deterged in the same Manner, as are the Air-Vessels of the Lungs in Coughing. But the Organs of Smelling communicate immediately with the Brain, whence it appears how Sneezing may directly operate upon the Brain, and how by this Action the Brain may be restored to many of its Functions; and hence, Men of acute Genius were formerly called (*emunctæ naris*) Men of a clean Nose.

§. 638. *Yawning* ^{*} is performed by stretching almost all the voluntary Muscles at the same Time, largely expanding the Lungs, and inspiring a large Quantity of Air very slowly and gradually; which being retained for some Time and rarefied, is again slowly and gradually expired, at the same Time that the Muscles are restoring themselves to their former natural Condition. Hence the Effect of this Action appears to be to move all the Humours of the Body through their respective Vessels, to accelerate their Motion, and to equally distribute them; and by this means it may very well adapt the Organs of Sensation and Motion, the Muscles of the Body, perfectly to perform their Functions.

^{*} In this Action the Air is first inspired in as large a Quantity as possible, slowly and continually, and then, likewise, it is slowly and strongly expelled, by which means the Thorax is first greatly expanded, and afterwards evacuated. In the first Action, the Motion of the Blood is accelerated through the Lungs towards the left Ventricle of the Heart, in such a Manner, that soon after a greater Quantity of Blood is sent to the Encephalon, whence a larger Quantity of Spirits are secreted, increasing the Force of the Brain and Cerebellum, and augmenting the Influx to the voluntary Muscles. In the other Stage of this Action, almost all the Muscles of the Body are successively expanded or stretched. We have a manifest View of this Action, when an Animal first wakes from sleeping of a sudden, as when a
Lion

Lion or a Tyger raise themselves from Sleep to advance towards their Prey, for then they first stretch all their Muscles, and afterwards throw themselves upon the Prey with incredible Swift-ness. In this second Act, therefore, of Yawning, the Spirits are equally distributed through all the Muscles; so that if any Vessels have been obstructed or collapsed by Rest or Emptiness, they are by Yawning and Stretching restored again to their Action; and hence it is, that Yawning accompanies the first Stage of the Paroxysm of intermitting Fevers.

§. 639. *But* ¹ for the Manner in which the Body is *erected* ², held *still* ³, *turned about* ⁴, *bent* ⁵ or *extended* ⁶ by the various Motions of the *Head* ⁷, *Neck*, *Back* ⁸, and *Pelvis* ⁹, together with the Motions of the *Shoulders* ¹⁰, *Arms* ¹¹, *Fore-arms* ¹², *Wrists* ¹³, *Hands* ¹⁴, and *Fingers*; likewise of the *Thighs* ¹⁵, *Legs*, *Ankles*, *Feet* ¹⁶, and *Toes*; the various *Motions* ¹⁷ of these Parts concerned in *standing* ¹⁸, *walking* ¹⁹, *dancing* ²⁰ or *capering*, *running* ²¹, *wrestling* ²², &c. by their respective Organs, make a Subject too large to be here explained with our intended Brevity; and therefore the Reader may consult *Fabricius ab Aquapendente*, *De motu locali animalium*, and *Borelli* in his laborious Work *De motu animalium*; for these are Things which admit not of being related in a Compendium, much less can they be demonstrated as the Nature of the Subject requires. But for a Knowledge of the Joints and Muscles, with their Insertions and Di-
rections,

rections, they are to be learnt almost only from the Tables of *Eustachius*²³, which supply a true Idea of their Nature to our Eyes; whence those Tables are worthy to be perpetuated.

¹ Having explained all those Actions which are in common related to Respiration, I pass to the local Motions, by which the Body and its Parts are transferred from one Place to another, to perform which requires an infinite Force from the Actions of peculiar Muscles.

² The Action of sustaining the Body erect, may very well excite the Admiration of all, who consider it with Attention. When we are in Health and Strength, we think we do nothing when we sustain the Body erect; when, at the same Time, if the Body be compared with a Person sleeping, we shall find, that we powerfully labour both with the Head, Jaws, Eye-lids, Cheeks, Neck, Breast, Back, Loins, Shoulders, Arms, Wrists, Hands, Fingers, Pelvis, Thighs, Legs, Feet, Toes, &c. all which are in a State of Violence so long as we live. When we raise ourselves up after Sleep, the Feet, Legs, Thighs, Back, and Loins, act powerfully to keep us erect; the several Articulations are by the Creator provided with respective Muscles, of which a Thousand act while we are awake to keep us erect, and which are relaxed and at Rest while we are sleeping; but because we daily repeat those Actions of supporting the Body, we are from thence not easily made sensible of them. But when a Person who is almost overpowered with Sleep, endeavours to give Attention to any Thing, it is then evident enough what a Force is necessary to keep open the Eye-lids, to retain the
Head

Head from nodding, and the Arms from collapsing; and even only to keep open the Eye-lids requires a greater Force than a Person can in that State support. But this Erection of the Body and Activity of the Muscles returns again, when the Influx of nervous Juice is rendered more copious and equable from the cortical Part of the Brain into the whole Medulla, and from thence throughout all the Nerves and Muscles. In a State of Vigilance therefore, philosophically considered, there are powerful Motions exercised, though by repeated Use they become insensible to us.

³ When we thus sit with the Body erect, the least Force applied will destroy the Equilibrium, and turn it from one Side to the other. When the Wrist and Hand are at Rest, the least Force will bend it; but one may sustain the Neck erected, and yet the least Force will bend it one Way or the other. But there are other Limbs which are not so indifferent to move any Way; for if we stand erect resisting an Adversary, or if we extend a Finger only, so that it cannot be bent, this will be evident enough; as also when a Wrestler fixes his Shoulders with a great Force, that his Arm may be moved or carried round towards that immoveable Part. This Rest therefore, or fixing of the Parts, is performed by our applying a more powerful and copious Influx of Spirits to the flexor or extensor Muscles.

⁴ Thus the Thigh is turned round about the Hip by the Musculi Marsupiales, and others inserted into its Trochanters; but the other Articulations of the Leg or Foot have little or nothing of a rotatory Motion. The Head of the Humerus is well known to be articulated by Enarthrosis, so as to be capable of turning round with a very ample Motion by the circumjacent Muscles.

⁵ This

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⁵ This Motion obtains chiefly in those Joints where the Bones are articulated together by Ginglymus; for then there is only a Flexion or Extension, there being generally but one flexor and one extensor Muscle there applied. But when a Motion of the Limb is required towards all Parts, it is necessary for the Bone to be supplied with a round Head, and to be articulated into a like Cavity, with a greater Number of Muscles guarding it all round. The Fore Finger is capable of a rotatory Motion; in order to which it is supplied with an Erector and Extensor, a Flexor, an Abductor, and an Adductor, by the successive Action of which the Finger is turned round; whereas the rest of the Fingers are only bent or extended.

⁶ Extension is a bending of the Limb contrary to the Direction of the former, so that Flexion and Extension are reciprocal Motions relative to each other; whence Flexion may, with respect to the extensor Muscles, be termed Extension, and the Reverse.

⁷ The Head and Neck are turned round, or drawn towards either Side, by means of the *scaleni* Muscles and *Mastoidæus* on each Side.

⁸ The moveable Thorax may be turned round upon the first Vertebra of the Loins, by the Contraction of the oblique Muscles of the Abdomen ascending and descending, by which the Ribs are drawn towards the Origin of those Muscles. For this Reason, the last Vertebra of the Back has two Cavities, whereas the rest of the Vertebrae have only one.

⁹ The Motion of the Os Sacrum is very obscure; but the Os Coccyx, which forms Part of the Pelvis, is so moveable in its Articulation with the Bottom of the Os Sacrum, that it can bend either forward or backward, as it does with a manifest Motion

Motion in the Delivery of Women. Hence in Women the Coccyx is seated more horizontally than in Men, so that by inclining inward it can the better sustain the Weight of the whole Uterus during the Time of Gestation. But in the Time of Birth the Pelvis is dilated, when by the Throws of the Infant, or Pressure of the Midwife's Finger, introduced in Ano, the Os Coccyx is bent backward, or thrust outward. But in Men the Coccyx is less flexible, and is likewise less incurvated or bent inward. One of our most considerable Anatomists observes, that the whole Assemblage of Bones forming the Pelvis, namely, the *Ossa Iliæ Pubis* and *Ischia*, may, by the Action of the recti Muscles of the Abdomen, more especially the oblique external Muscles, be drawn upwards, without any Motion betwixt the Bones themselves; but by removing the Os Pubis from its Place forward, the Pelvis will be raised upward and outward, which Action we observe at the Time of Delivery. It does not seem credible that the *Ossa Pubis* separate from each other in the Time of Parturition, since this is repugnant to anatomical Dissections, and to the firm Connection or Union of these Bones, which is such, that they can hardly be divided by the Butcher. But this is altogether probable, namely, that the Assemblage of Bones forming the Pelvis, are in their fore Part towards the Os Pubis drawn outward, by the Contraction of the oblique, external, internal, and recti Muscles of the Abdomen, whence the Distance is increased betwixt the Os Sacrum and the Os Pubis by raising the latter. Hence then the Capacity of the Pelvis is enlarged, and a more easy Way made for the Exclusion of the Fœtus.

¹⁰ The Scapula in Men affords a Basis to sustain the Muscles moving the Arm, Cubitus, and Wrist, upon whose Action the Strength of the Person depends; for all these Muscles are supported only by the Scapula, which is nevertheless, in itself, moveable. The Condition and Motion of the Scapula is therefore twofold. 1. As when all the Muscles of the Scapula act together, and render the same so fixed or immoveable, that it can scarcely be drawn to any Side. 2. When the Scapula itself is moved from one Place to another.

¹¹ In Man, Moles, Dormice, Monkeys, &c. the Humerus is articulated with the Scapula almost flat by Enarthrosis; for the Head of the Os Humeri is a Segment of a most smooth Sphere, being connected not into a Cavity, but almost into a Plane and very large Process of the Scapula; but from that Plane a Margin arises all round excavated, namely, the glenoide Cartilage, which growing to the Surface of the Bone, forms a Cavity, within which the Head of the Humerus is moved, being capable of describing an infinite Number of Cones when the Limb is well constituted. Therefore Nature has made the Articulation simple, without adding any Ligament to the Head of the Bone, as we observe in the Center of the Head of the Femur, from whence a round Ligament, like a Cord, is inserted into the Center of the Acetabulum; for it was necessary that a much greater Number of Cones should be described by the Humerus moving upon the Scapula, than in the Os Femoris moving in the Acetabulum.

¹² The Arm is bent and extended by the Ulna, but is turned forward or backward, by means of the Radius, which has a Rotation. In the Pronation

tion of the Cubitus, the Muscles are twisted, while the Articulation of the Ulna, with the Humerus, continues unaltered, as does also the lower Head of the Ulna towards the Carpus; but the Radius turns round upon an Excavation in the Head of the Ulna, so as to describe the Arch of a Circle: Likewise, in Supination, the Radius is in the same Manner turned round upon the Ulna, but in a contrary Direction.

¹³ If any one was to consider the Articulation of the Wrist as much as it deserves, it would take up, in Reality, a whole Year. The Carpus is composed of eight small Bones, each differing in Figure, Magnitude, Articulation, and Connection, both to each other, and to the Radius and Ulna on one Side, and to the four Bones of the Metacarpus on the other Side, as also to the Bone which sustains the Thumb. With their metacarpal Bones, those of the Carpus are connected by numerous Ligaments of their own. But besides all this, they have each of them a Periosteum, and a kind of cartilaginous Crust of their own, together with Ligaments, and a Capsula full of the lubricating Liniment of Havers, which is continually expressed from the Cells into the Articulation betwixt the moving Surfaces of the Bones. Hence proceeds that wonderful Mobility of these Bones, by which they are enabled to assume all Directions, by turning round and bending an infinite Number of Ways. If only one Capsula is vitiated, so that no Fat or Liniment can be sent into that Part, then the Bone of the Carpus adheres to the next adjacent Bone, whence follows an Anchylosis from a Defect of the oily Liniment, as frequently happens oftener than is imagined, or else an anchyloide Tumor is formed, incapable of receiving any Cure.

¹⁴ The Metacarpus or Palm of the Hand is capable of expanding itself into a Plane, and of forming itself into a Hollow, being *Diogenes's* Cup, and last Shift, by which he was enabled to drink without a Vessel; even it may be almost formed into a Cavity on the Reverse or back Part of the Hand. These Actions result from the Mobility of the metacarpal Bones, which are capable of bending almost any way among each other.

¹⁵ We may adore the Creator in contemplating the wonderful Articulation of the Femur, which is provided with very strong and large Muscles, that being slender of itself, it might yet be able to support and carry the whole Body; the Neck of the Femur we find bent outwards, the Bone itself being inclined inward, that in walking it might sustain the Body without rubbing against the other Bone to which it is articulated. As this Bone sustains the whole Weight of the Body above, therefore the Head of it is inserted out from the Bone very firmly indeed, but yet is itself a distinct Epiphysis, as we see in young Subjects. Besides this, a Ligament arises all round from the Margin of the Head and Neck of the Femur, and which is firmly connected to the whole Margin of the Acetabulum, so that the Head of the Femur may move freely in this Capsule, and yet not be apt to slip out of the Articulation; to prevent which, there is also a large Ligament passing from the Center of the Head of the Femur, into an Excavation in the Acetabulum, being itself inclosed within a Capsule or Covering, which *Ruyseh* affirms to consist entirely of Vessels; to which add the mucilaginous Cryptæ, which discharge their Contents by the Motion of the Femur, pouring out a Liquor like the White of an Egg for lubricating the whole Articulation.

But the Neck of the Femur is composed of a very thin bony Lamella, not much thicker than one's Nail, but compact and spread over the rest of its Substance, which is altogether cellular; and this, because a great Part of the Medulla contained in the Femur, ought to be derived into the Cavity of this Articulation, which could not have been done without making this Part of the Bone cellular. Hence it is, that lean People endeavouring to walk too long Journeys, perceive a kind of Pain in this Part. This is the Seat of ischiatic Disorders, when either the Fat or medullary Oil is deficient, or else this Capsule inflamed or suppurated. Concerning which Disorder, *Hippocrates* says, that if it does not give way to Medicines, the Caution must be tried; and if that does not succeed, the Limb, consequently, will become paralytic. But the Ligament, concerning which we spoke before, suspending the Head of the Femur, is so strong, that it will not suffer the Bone to be dislocated, though a Man be hung up by his Feet, and even though a Thousand Pounds Weight were to be appended to his Head. Hence it is, that the Femur can never be luxated by external Causes, as *Du Verney* and *Ruyfch* have observed; for they always found, in their numerous Dissections of lame People, that the Head of the Femur was never dislocated from the Cavity of its Articulation, but that the Femur had been always fractured in its Neck, which is of no great Strength; whence the Surgeons concluded the Fracture to be a Luxation, as *Du Verney* found an hundred Times by Dissections. For though the Head of the Femur may be sometimes dislocated by a Relaxation of the Ligaments, and a Tumor of the mucilaginous Gland fixed in the Acetabulum in People troubled with ischiatic Disorders; yet the same cannot take Place

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Place from external Causes, this Articulation being defended by very strong Muscles; nor yet, when the Neck of the Femur is fractured, can the Surgeon prevent the lower Part of the Bone from descending, while the Head of it continues fixed in the Acetabulum. There are some People who, after this Accident, have had a new Capsule formed by the Femur amongst the Muscles, producing a kind of secondary Articulation, so that during the rest of their Life, in walking, they are obliged to throw the Weight of their whole Body upon the sound Leg, inclining so as to bring the Center of Gravity over the Middle of the displaced Femur. Lastly, A sound Person is capable of standing upon one Thigh, while the other describes an infinite Number of Cones, by turning round the Femur, outwards and inward. It is finally remarkable, that the Os Femoris inclines with a small Incurvation from its Neck downward.

¹⁶ Almost all the seven Bones of the Tarsus are connected with the Astragalus, much in the same artificial Manner as we observed in the Bones of the Hand.

¹⁷ He that undertakes to explain the various Motions of the Body, ought to be well acquainted, (1.) with the several Articulations of the Bones; (2.) with all the Muscles and their History; (3.) the Actions of each Muscle separately, and in Conjunction with others destined for the Motion of each Articulation.

¹⁸ We stand erect when our Feet, Ankles, Legs, Thighs, and all the Vertebrae, with the Head, are erected by their respective Muscles. This is a very difficult Action, as it includes the Power of such an infinite Number of Muscles; and therefore, in Plays, it is one of the most difficult Tasks to render all the Limbs and the whole Body rigid like a Statue; in order to which there ought not

to be the least Motion perceptible in any Part ; but so great a Weakness follows from this Action, that a Person is scarce able to retain himself from falling. What has been observed with respect to the whole Body, is also true in the Arm, or any other particular Part, which, if endeavoured to be held immoveable for a long Time, will become so painful as to oblige the Person to desist.

¹⁹ Walking is performed by bending the Foot upon the Tibia after standing, by bending the Tibia at the Femur, and the Femur at the Acetabulum ; for we can never go forward without bending the Femur. A Person who endeavours to walk forward, first bends his Foot and Leg, by which they become shorter, and then throwing the whole Thigh forwards, while the Weight of the Body is sustained by the firm Leg, the Center of Gravity is next moved forward, so as to fall upon the foremost Foot, upon which it is rested, while the other Foot is moved as before. We do not therefore advance any Thing while we stand upon both Feet, nor are we then in Danger of falling even upon the Ice ; but the Danger of falling is when the Body is thrown forward standing upon one Foot. A Person who steps against a Stone falls forward, because the foremost Foot is not soon enough fixed to receive the Center of Gravity of the whole Body.

²⁰ *Aristotle* proposes a Question, why a Person cannot dance or caper in Sand, whereas they can perform well upon a tight Rope ? The Reason is, because, in dancing, the Thigh, Knee, and Ankle, require to be bent, and to be again suddenly extended with a considerable Force, by which Means the whole Body will be raised or lifted up, if the Foot stands upon an elastic or resisting Pavement. Hence, therefore, no one can dance with their

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Legs strait, nor without a due Resistance to their Feet; since it requires a Force to bend the Joints, and again to suddenly extend them. We do not here speak of that Kind of Dancing in which the Body is agitated in various Manners, but of that in which the Center of Gravity of the whole Body is elevated from the Ground.

²¹ In Running, which is swifter than Walking, there are some so expert, that they can raise their Feet with very little Fatigue or Loss of Spirits, erecting them in such a Manner, as to shew the Sole of the Foot to one who stands behind; and for this Reason, and no other, they are more liable to fall, as *Virgil* observes, *Æneid*, V. 330.

²² The Art of Wrestling consists in supporting or maintaining the Center of Gravity of the whole Body, by keeping the same in a right Line; in order to which, we must endeavour to keep the Center of Gravity of the whole Body upon a Line passing through the Middle of the Soles of the Feet; and then, if our Antagonist is not cautious, we may throw him by resisting only, without Impulse. But this Rule is opposed by another, which directs us to keep our Antagonist in such a Posture that he cannot throw us.

²³ Those Tables of *Eustachius* demonstrate the Organs of Motion successively, as provided by Nature. The Author seems to have intended them to supply the Defects of *Vesalius's* Tables; nor has he left any Opportunity to find Fault with them. To these add, *Fabricius ab Aquapendente* and *Borelli*.

§. 640. Having hitherto (§. 39 to 640.) considered and explained the vital, natural, and animal Actions, with respect to their Or-

gans and Causes in *common* ¹ to Adults both Male and Female; it therefore now remains for us to explain those Functions or Actions by which our Species are propagated, and which are peculiar to each Sex: But these are not only different according to the Difference of the Sex, but also according to the Age of each Sex.

¹ Both Male and Female agree without any Difference in the Head, Eyes, Brain, Nose, or other Senses, with the several Muscles; but in the Parts subservient to Generation, they are altogether different, except in the Origin of the spermatic Vessels, which yet are not always alike. Add to this, that the Distance betwixt the Shoulders in Men is larger than that in Women, whereas the Distance betwixt the Hips of these latter, is larger than in Men. This Difference is not the Effect of Time, being present in the first Formation; and therefore having explained those Parts which are common to both Sexes, it remains for us to consider such Parts as are peculiar to each. A female Foetus of five Months old appears like a Male, since at that Age the Clitoris and Nymphæ are very large and pendulous; but in the ninth Month they are contracted inwards; and from hence arose the Saying, that the Female has the male Parts introverted, and that the Male has the female Parts extraverted; and from hence likewise Women who miscarry, imagine the Abortive to be a Male, when by dilating the Parts with the Finger, it appears to be a Female.



Concerning the Origin and Nature of
the MALE SEMEN.

§. 641. **T**HE spermatic Arteries arising from the anterior Part of the Aorta under the renal Arteries, almost *constantly* ¹ observe the same Rise, though sometimes (perhaps *improperly* ²) the left Spermatic is said to arise from the emulgent Artery of the same Side. They are *not large* ³, and by reason of their *oblique* ⁴ Descent from the Aorta, are capable of receiving but a small Quantity of Blood; they descend obliquely, and then join in an acute Angle with the spermatic Veins on the same Side, of which the right comes from the Cava under the emulgent Vein, but the *left arises from the emulgent* ⁵ Vein of the same Side, yet so that Nature often varies in the Origin of these Veins; which joining together at an acute Angle with the spermatic Arteries, are both together included, and in a Manner intimately *blended together* ⁶ in a *common* ⁷ membranous Vagina or Capsule; by which they are defended under the interior Lamella of the *Peritonæum* ⁸ which is spread over them; and thus running down over the *psoas Muscles* ⁹ and Ureters, they at length reach the Rings of the Abdomen, through which they

pass out in each Inguen, where the fleshy Fibres of the transverse Muscles, which in many People descend so low, cover them before; and the oblique inferior Muscle receding a little from the former, transmit these Vessels included in their membranous Vagina, in such a Manner that the Aperture through which they pass in the transverse Muscle is highest, the other Aperture transmitting through the oblique ascending Muscle being lower; and then about three Lines lower, they again pass through an oval Aperture or Ring in the tendinous Part of the oblique descending Muscle, from whence at length the membranous Vagina and its contained spermatic Vessels ascend over the Os Pubis, and from thence pass into the *Scrotum* ¹⁰, where, by a Complication of these Vessels and their Membranes, is composed the Testicle itself, *invested* ¹¹ by its proper cremaster Muscle (which arises fleshy from a large Part of the lower and anterior Face of the Spine of the Os Ilium; from whence descending obliquely with its fleshy Fibres connected to the anterior Margin of the Os Ilium towards the Os Pubis, from thence expanding forward obliquely downward and to each Side, it embraces the Tunica Vaginalis, while the fleshy Fibres from the anterior Part of the Os Pubis descending directly downward behind the Vaginalis Tunica, apply themselves to the back Part of the same Tunic, and by that means form a hollow Muscle), strictly closed on all Sides, by which that Tunic and the Testicle is drawn up, sustained,

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stained, compressed, and its Juices expressed ; but throughout all this Course, the Spermaties in several Places detach very small lateral Arteriolæ ; and to this add, that they acquire a thin Membrane in passing through the three several Apertures of the abdominal Muscles ; but near the Body of the Testicle, the spermatic Veins form, by their mutual Anastomoses, the *Corpus Pyramidale*¹².

¹ For these arise pretty constantly in the same Place both in Men and Women. *Eustachius* expressing the emulgent Vessels in his Tables, taken from a Hundred different Bodies, has not one Figure in which the spermatic Arteries arise above the Emulgents. Hence there seems to be a Reason of great Importance, why the spermatic Arteries should always arise from the same Part of the descending Aorta below the Emulgents in all Kinds of Animals. We are indeed not yet acquainted with the Reason of this, which perhaps may be discovered by Posterity ; but from this perpetual Observation has arose that ancient Phrase of the *Hebrews*, *For Children to come from the Loins of their Ancestors*, Gen. xxxv. 5. and 11.

² *Galen* first, and afterwards *Leal Lealis* in an accurate Treatise upon the Organs of Generation, have taught, that the spermatic Arteries and Veins take the same Course to the Testicles ; and even myself was seduced, by their Authority, to believe the Observation true : But I have since had several Opportunities of seeing what imposed upon those eminent Anatomists, and which may still impose upon the most penetrating Enquirer. I have asked all the Anatomists, with whom I am acquainted, Whether they ever saw the left spermatic

tic Artery arise from the renal Artery of the same Side either in Man or Woman; since we are certain, that the spermatic Vein of the same Side always discharges its Blood into the left emulgent Vein, and not into the Cava. Upon the whole, I find the Matter thus: The spermatic Artery at about an Inch Distance from its Origin meets the spermatic Vein of the same Side, and is included therewith in the same Capsule or vaginal Tunic in which they are complicated together in such a Manner, that you would be ready to affirm the left spermatic Artery arose from the left emulgent; but when the Integument or Capsule is laid open, and the cellular Membrane gently separated to farther expose the seminal Artery and Vein, you then find that the Artery does not terminate in the Fat of the Kidney, but being invested therewith, it goes on, in a transverse Direction, to be inserted into the anterior Face of the Aorta; for the Aorta is less distant from the left than from the right Kidney, because it descends along the Vertebræ more inclined to the left Side, as *Eustachius* represents it in all his Figures; and thus at length, by freeing the Membranes by the Scalpel from the Vessels, I discovered the Opinion of *Lealis* to be false. But *Hippocrates* has pronounced that Males are generated from the right Testicle, and Females from the left, so that by making a Ligature upon the left Testicle, the Animal will beget nothing but Males. But it is not probable that *Hippocrates* in this Place speaks from his own Experience, because Animals were known to generate both Sexes, though one of their Testicles had been extirpated; namely, in those Animals which are capable of being confined from mixing or adulterating with others, which is difficult to be done in the human Species, for there are few Women like *Penelope*. *Leal Lealis* has

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endeavoured to explain the Opinion of *Hippocrates*, which makes the left spermatic Artery arise from the left emulgent, by saying it is because the Blood received from the left emulgent is more watery, and replete with Urine; whereas the Blood of the right spermatic Artery is derived from the Aorta, and is therefore less excrementitious: But all this Hypothesis is without Foundation.

³ They are even much smaller than one would imagine in strong Men, and in Horses themselves, who have, nevertheless, large Testicles; whence it follows, that much less Blood is sent to the Testicle, than is commonly supposed, since the Artery is a Cone, whose Base hardly admits of a writing Pencil.

⁴ They arise at an acute Angle from the Aorta, which descends through the Middle of the Loins, and on each Side sends off the emulgent and lumbar Arteries, almost in a perpendicular Direction; whereas the spermatic Arteries descend at no great Distance from the Aorta, so that if a right Line be drawn from the Navel to the Os Pubis, the Notch through which the spermatic Vessels pass over the Os Pubis, will hardly be found two Inches distant from the right Line. But according to the Proposition of *Euclid*, *Lib. I. c. 6. p. 11.* If two right Lines are drawn parallel to each other, every Parallelogram drawn betwixt those Lines will be equal, whether their Sides be square, or oblique and unequal. In the same Manner every Parallelopiped comprized betwixt two Planes is equal to one another. The same is also true with respect to the seminal Arteries, which do not contain more Blood than if they were of the Length of two Inches, which is the Height of the Parallelogram mentioned before. In my publick Lectures I formerly reduced this to a Calculation

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lation, and demonstrated that the Orifice of the Canal is smaller, as it forms a more acute Angle with the Trunk from whence it arises. But from this so small Quantity of Blood, the greater Part is sent aside; since, when the Artery arrives to the Testicle, it divides into three Branches, only one of which supplies the Testicle; whence it appears that the Semen is separated from a very small Quantity of Blood.

⁵ For if this Vein arose from the Cava, it must have passed over the Aorta, by whose Pulsation it might be broke.

⁶ The spermatic Artery and Vein being received into this common Capsula, seem confounded together by mutual Anastomoses. This was first observed by *Galen*; but the Moderns, after the Discovery of the Circulation of the Blood, have exploded the Opinion; but *Leal Lealis* has renewed the old Opinion, having seen with the Eye, in the spermatic Artery of a salacious Animal, that the Blood passed by lateral Branches from the Artery into the adjacent Vein. Relating this Opinion formerly to *Raw*, I desired him to make the Experiment; but he derided the Notion till he was afterwards convinced of the Fact by Experiment. When I heard that the much desired Tables of *Eustachius* were publishing at *Rome*, I had great Hopes of seeing this Point decided in those excellent Tables; and I afterwards found that this Anastomosis of the spermatic Arteries and Veins, was expressed in all the Figures of that great Anatomist. The like has been also observed by Dr. *Mortimer*, *Phil. Transf.* N° 415. But this is a Peculiarity of the seminal Artery only, by which Contrivance the Quantity of Blood is diminished from whence the Serum is prepared: For since the Vein is much larger in Proportion than the Artery,

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Artery, it follows, that almost all the Blood, brought by the latter, will return through the Vein, so that a very small Portion will be sent to the Testicle; for it is well known how turgid the spermatic Veins are in a healthy Man. But at present, *Ann.* 1732. there are many who deny any other Anastomoses betwixt the spermatic Artery and Vein, besides what is in common to the other Blood-Vessels; otherwise it would indeed follow that the arterial Blood, finding a less Resistance in the Vein, it would return that Way without ever entering the Testicle.

7 The spermatic Artery and Vein are contained in one and the same Capsule, the like of which is hardly to be found in any other Part of the Body. This Capsule prevents the spermatic Vessels from fluctuating, by fixing them down to the Loins, while, at the same Time, the cellular Membrane lubricates them, without containing much Fat to obstruct or compress them, and prevent the Course of the seminal Matter. We know that Man becomes emaciated by encouraging Venery, whereas castrated Animals grow fat.

8 *Du Verney*, first, rightly observed to us, that the seminal Arteries arise from the Aorta, which is itself placed under the interior Lamella of the Peritonæum withoutside the Cavity of the Abdomen; but that the Peritonæum being equally expanded on all Sides, forms a Cavity, in which the abdominal Viscera are contained, but that the Aorta is placed beneath and withoutside of that Cavity. But thus we are taught, that the spermatic Vessels are likewise placed on the outside of the Membrane of the Peritonæum, in which Manner they pass to those Apertures, through which they perforate the abdominal Muscles, which here leave Rings for the Course of the spermatic Vessels.

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These Rings are covered over by the Peritonæum, which yet does not pass through them together with the Vessels, which it serves only to cover. The Peritonæum must therefore be here extremely weak; for being resisted or supported throughout its whole Extent by the incumbent Muscles, it has here nothing to support it but the seminal Vessels, which from thence descend inward without being accompanied by the Peritonæum, which being here extremely thin, will be most liable to form true Herniæ, whenever the Peritonæum, which covers the Rings of the abdominal Muscles, transmitting the seminal Vessels, is by violent coughing, or other straining, extended into a Sacculus without bursting; which Sacculus being protruded by the Sides of the seminal Vessels, enters the Scrotum without ever including those Vessels. When this Sacculus of the Peritonæum contains Water, it is an Hydrocele which may be easily cured; when it contains elastic Air, it is a Pneumatocele, which it is likewise not difficult to remove; but if the Sacculus contains the Omentum fluctuating and prolapsed, it is an Epiplocele; and if any of the Intestines prolapse into the same, it is an Enterocèle. From hence it appears, why Ruptures are so frequently found in this Part; and that the Disorder is nothing more than a Dilatation and Protrusion of the Peritonæum through the Rings of the abdominal Muscles, so as to form a Sacculus or Cavity; and that therefore it is improperly called Rupture, since the Peritonæum is only dilated laterally into a Sacculus. From hence also it is evident, why those who have Ruptures are frequently sterile. For the spermatic Vessels often adhere to the hernial Sacculus, which, if thrust into the Abdomen, the Testicle is at the same Time drawn up, whence Convulsions

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vulsions follow. But even afterwards the Membrane encompassing the Muscles grows to the seminal Vessels, and Tunica Vaginalis, which fastens the spermatic Artery and Vein together, where they pass through the lower tendinous Ring of the Muscles; and from thence passing over the Os Pubis in Men, through a sort of Notch in the Bone, they enter the Scrotum. To this Part the Compress of the Truss ought to be applied, for sustaining reduced Ruptures.

9 The psoas Muscle stimulates, by its Motion, the incumbent spermatic Vessels, so as to cause a more quick Separation of the Semen; and hence this Muscle is frequently agitated in fallacious Animals, and the less it is agitated, the less Semen is separated. The adjacent iliacus Muscle performs likewise nearly the same Action.

10 *Ruysch* first rightly taught that the Scrotum is partitioned into two Bags by a Mediastinum, which is thick and double, composed of the two Sacculi together, within each of which there is a Membrane investing the Testicle, and receiving an intermediate Vapour betwixt itself and the Testicle. Upon dissecting the Tunica Vaginalis from the Testicle of a Horse, a good deal of Water may be expressed, which prevents the Concretion of the Tunic; but this Water hardens with the Heat of the Fire. When this Water is collected without being absorbed, it forms an Hydrocele; but when it is altogether absent, the Membrane concretes together with that of the Testicle itself, which produces an uneasy Stricture. Under the Skin of the whole Body is placed the cellular Membrane; next to that in the Scrotum lies the Dartos Muscle corrugating the Testicle, and differing from the Cremaster, since it descends from the very strong Ligament of the Penis, in a Manner best described
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by *Morgagni*. It may perhaps seem surprising, that one of the most noble Humours of the Body, from whence our Offspring is derived, should be conveyed out of the Body in such a Manner, that a Wound inflicted might easily destroy the generative Faculty; insomuch that Castration can be nowhere better performed, if it was not for Fear of the Hæmorrhage. Nature seems to have provided all this, that the feminal Blood might be cool, and rendered as slow as possible in its Motion thro' the Testicle, than which no Part of the Body is more cold.

¹¹ Hitherto the Capsule containing the spermatic Vessels is composed of the Vagina, derived from the Origin of these Arteries and Veins; to which is added another Vagina, received near the external Ring of the abdominal Muscles; from whence it passes into the Scrotum, being frequently the Seat of dropical Tumors, so as to be distended to the Thickness of four Fingers. But the spermatic Vessels descending over the Os Pubis towards the Scrotum, are there embraced by broad fleshy Fibres of a double Series in the Manner of a Case; which likewise invests the whole Testicle as a muscular Bag, compressing the same at the Time of Coition, and forwarding the Excretion of the Semen, as well as the Circulation of its contained Humours. This Muscle is by some called Cremaster, and by others Tunica Erythroides. In Horses this Muscle is so strong, as to compress the Testicle as if it was betwixt two Hands; tho' the Testicle is so large in that Animal, that from thence *Malpighi* testified he first learnt the Fabric of the Glands. I have myself seen the Testicle drawn up, not only to the Os Pubis, but also over the same Bone, together with the spermatic Vessels, into the Abdomen.

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¹² It is a wonderful Property of the spermatic Artery, that it should be larger, as it recedes farther from the Aorta; and, on the other Hand, as the spermatic Veins are more remote from the Cava and Emulgent, the larger they are likewise, contrary to what we observe in all the other Parts of the Body; and yet before the spermatic Artery enters the Testicle, a large Part of the Blood may possibly be derived into the Vein by the lateral Anastomoses; from whence it is evident, that Nature aims at something particular in this Fabric.

§. 642. In this Course the spermatic Artery being *a little inflected* ¹ in a spiral Manner, sends out small arterial Branches, which seem to open laterally, so as to discharge the arterial Blood by an ample, streight, and open Course into the adjacent Vein, with which it forms true Anastomoses, more especially in the Corpus Pyramidale, where the spermatic Artery near the Testicle gives *a Branch* ² to the lower and inner Part of the Epididymis, spends small Twigs on the Testicle itself, afterwards terminating in the nervous Tunic; and sometimes also it sends another Branch to the Top of the Testicle, but always a large Branch to the upper and larger Part of the Epididymis, where it is ramified and distributed to all Sides; besides many small Branches from the larger Trunk intimately wove together with the small Veins in the pyramidal Body, and afterwards spread round the Testicle.

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¹ Whereas in Brutes they are wonderfully contorted into Spires and Semicircles, but in Man this same Artery has no considerable Contortion.

² Which Branch afterwards hardly enters into the Testicle. It also sends Branches to the thick Tunic formed by the Vaginalis, of the Testicle, adhering to the adjacent Parts. So small therefore are the Arteries which furnish the Testicle like the Brain; so that there is not any red Blood to be found within the Testicle, as some Anatomists have mistakenly affirmed. *Ruysch*, who was the most happy at injecting the Arteries, could never prepare the Testicles by that Artifice; but by making an Incision in the Tunica Albuginea, he inverted the Testicle, and afterwards macerated the same in warm Water, by which Means the seminiferous Tubes were loosened from each other in Bunches; and even after he had most exquisitely injected the Testicle, there appeared only a few very small Branches dispersed here and there, rather upon the Cells than the Substance of the Testicle. Hence it follows, that the red Blood does not enter the true Substance of the Testicle, as a modern Anatomist has rightly affirmed; and hence, as I before observed, the Semen is formed rather by Incubation, than according to the Laws of Circulation. But the interior Fabric of the Testicle consists of an infinite Number of Cells distinguished by membranous Partitions, which divide the whole Testicle into so many *Lóculi*, within which the red Blood never enters; for even in the large Testicles of the Ram, one can discern small Blood-Vessels only betwixt the Cells, whereas no red Blood can be found in the Middle of their Substance, in the same Manner as none is found in the cortical Part of the Brain. *Dathirius*, Physician at the Court of *Tuscany*, has demonstrated

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monstrated that the spermatic Artery, having reached the intimate Substance of the Testicle, does no longer convey red Blood; and therefore the sanguiferous Artery derived from the Aorta to the Testicle in so long a Course, does by its particular Fabric expel the red Blood; all which red Blood seems to be sent by true Anastomoses into the corresponding Veins, into which the lateral Branches of the Arteries are inserted, and are in some measure spent upon the Membranes of the Epididymis and Partitions of the Cells. But the smaller Arteries, which do not admit the red Blood, are invisible, white, and convoluted within the Cells formed by the membranous Partitions, terminating, at last, in exhaling Ducts without any corresponding Veins, as if their Extremities were cut off, by the Mouths of which the prepared Semen is discharged. *Leal Lealis* says, that these Extremities of the Arteries open into the white Substance of the Testicle as into a common Cavity, and that a small Bristle may be inserted into the Artery through the open Cavity; but if the Artery be pressed, it discharges the Blood itself; but gradually changing its Nature, it becomes first of a cineritious Colour, and afterwards white, conveying a Liquor like unto the Semen. But from these Cells, in brute Animals at least, there arises only one large Canal, which receives its Denomination from *Highbmore*; and in this Duct the Cells are absent, this being the Receptacle into which the Testicle discharges the ash-coloured Semen. This Duct is narrower in the upper Part of the Testicle, and, being inflected, forms the Epididymis, which is a Receptacle in common with the Ductus *Highbmori*, where the Semen is received from the Cells, as the Cells receive it from the open Mouths of the Ar-

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teries, as was first described in brute Animals by
Dathirius.

§. 643. For the pyramidal Body arising from the Back of the Testicle, called likewise *Corpus Varicosum vel Pampiniforme*, consists of innumerable *Veins*¹, communicating together, and forming, as it were, a Net, till they at length unite and terminate in one spermatic Vein; and thus the Blood has a commodious Opportunity to discharge itself into these Veins.

¹ There are no sanguiferous Veins arising within the Substance of the Testicle, and those which appear without-side the Testicle belong only to its membranous Partitions; but those Veins placed betwixt the Cells, composing the *Ductus Highmori*, are not sanguiferous, but pellucid at their Origin, escaping the Sight; but when they arrive at the *Corpus Pyramidale*, they pass out together with the external Vein. Now in all Animals the Semen is continually separated, and in many it is retained for a long Time, without being discharged, as in Bulls, Horses, and other domestick Animals which are confined; and yet those Animals do not in the mean Time lose their generative Faculty, nor do their Testicles swell or receive any Injury. But those Animals are partly destitute of seminal Vesicles, and Part of them have none sufficient to receive all the Semen, which is thus made. Whence it follows, that the Semen must be absorbed again by invisible Veins, in Proportion as it is secreted. These Veins, like the Arteries, return out of one Part of the Testicle, and compose the *Corpus Pampiniforme*, which is at least

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least twenty Times larger than the spermatic Vein, into whose Cavity it is inserted; and yet is this whole Body, except a very few small Arteries, composed entirely of small Veins, so that there is not, perhaps, any Part of the Body, where the Veins are so large and numerous in Proportion to the small Arteries. But this Body seems to be made up entirely of a Congeries of absorbing lymphatic Vessels, which return the superfluous Part of the seminal Fluid into the Veins, which carry back the superfluous Blood remaining after the Nutrition of the Testicle. These Veins return very slowly the Fluids passing from the Testicle; for the smaller the Artery is in Proportion, the more slowly does the Blood move through the Vein. But the Trunk of the spermatic Vein arising from each pampiniform Body, is inserted on the right Side into the Cava, and on the left, into the emulgent Vein of the same Side; the Cause of which Difference is not difficult to understand, since the left spermatic Vein could not have reached the Cava, without passing over the Aorta, by whose Force it might have been injured, compressed, or broke; and therefore it is more commodiously inserted into the large left emulgent Vein.

§. 644. Those Arteries which penetrate the nervous Coat of the Testicle, being gradually ramified into small Branches, which are placed in a distinct Order, are at length spent in an infinite Number of smaller Branches, which, at last, end in most minute capillary Vessels, which are distributed almost throughout the Testicle, and perhaps discharge their Humour, by an infinite Number of Mouths,

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into larger Vessels *orderly disposed*¹, and at last terminating in one great Duct, continued through the Middle of the Testicle to the Epididymis; so that these Arteries have no Veins but terminate in excretory Vessels.

¹ This whole Disposition of the Vessels does not appear with sufficient Evidence in the human Testicle; but we are herein assisted by the Testicles of a Boar, which are very large in Proportion to his Body, as also by those of the Dormouse, in which the Fabric is very evident. Yet does not the Fabric of the human Testicle seem much different from those of brute Animals, although the Fabric is more subtle or obscure. Therefore the arterial Blood derived from the Aorta, below the emulgent Veins, in a small Quantity, and with a slow Motion, is returned into a Vessel incapable of resisting, in which its Return is forwarded by a gentle lateral Motion, parallel with the Course of the Aorta; to which add, the small Arteries of the Tunica Vaginalis, and the numerous Anastomoses betwixt the Veins. But a small Portion of the Blood remaining in the Artery, is conveyed to the Body of the Testicle by three small Branches, into which the spermatic Artery divides; but that Portion of this arterial Blood which is not red, and conveyed with a slow Motion into the Substance of the Testicle, enters those Heaps of white Vessels, capable of being unravelled by macerating in the Manner of *Ruysch*, so minute, that I have never yet been able to discover either their Number or Termination by the Microscope, even though they seem to be disposed in a regular Order, according to the Cells in brute Animals. These Heaps of Vessels are folded round each Cell, that they might be reduced into
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the least possible Compass, and be rendered capable of most powerfully retarding the Motion of their contained Humour; but they at last terminate with open Mouths, which distil the Semen like Dew into the Cells, of which there are, at least, twenty-four in the Testicle of a Boar. From each of these Cells the Semen is conveyed by distinct Canals, which all terminate in the Ductus *Highbori*, by a Contortion or Reduplication of which is formed the Epididymis. The whole Testicle therefore is externally covered with red Blood, receives the Pulsation of the Arteries, and digests the Semen, which yet is not separated from sanguiferous Vessels, but from smaller Arteries than those which admit the red Globules.

§. 645. But these seminiferous *Arteries*¹, (§. 644.) terminate in the *Epididymis*², and discharge their Humour into the Cavity of that Canal, much in the same Manner as we observe in the lactiferous Tubes of the Breasts in Women; for the Epididymis is one continued hollow cylindric Vessel, complicated into many Folds, which are joined together upon the Body of the Testicle spread with small Arteries, and terminating into a single *Vas Deferens*³ vel Ejaculatorium, which arising up over the *Os ubis*⁴, descends into the Pelvis, and approaching towards the back Part of the Neck of the Bladder, is there inserted into the seminal Vesicles.

¹ It is highly probable that the whole Testicle is a Production of the spermatic Artery. I am

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indeed sensible, that the Smalness of this Artery will be objected, since it is very inconsiderable in Proportion to the Testicle; but the same Difficulty may be raised with respect to the Brain, since the Arteries sent to the Encephalon are equally small, in Proportion to the large Bulk of the cortical and medullary Substance; and therefore there is but a small Quantity of red Blood sent by those Arteries through the Medulla of the Brain. So much Similitude is there in the Fabric of the Brain and Testicle; in which last also the arterial Branches are much larger in Proportion to their Trunk, because they deposit their muscular Coat.

² The Epididymis has a different Fabric in Man, to what it has in Brutes. *Ruysh* first demonstrated, that when the human Testicle is perforated with a slight Incision through its nervous Coat, without wounding its Substance, that Coat may be then inverted, and its Fabric turned outward; and if then the Testicle be macerated and shook daily in Water, shifting and renewing the Water as often as it becomes turbid, the vascular Compages will be then unravelled in such a Manner, that the whole Testicle will appear a Heap of fluctuating Vessels filling the glass Vial; and by this means you will perceive the Difference betwixt the Fabric of the human and brute Testicle. But here our Enquiries end; for no Injection can demonstrate any Thing in the Integuments. But so much as is destroyed by macerating and washing, what that is, or in what Fabric disposed, we are altogether ignorant. Add to this, that in Man there is no *Corpus Highmorianum* formed, by the lateral Cells discharging the white-coloured Semen, and terminating in the Epididymis; but there are only five or six Canals instead of one, which joining together, come from the Surface of the Testicle to the Epididymis. Hence it

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it appears, that the Fabric of the Testicle is more intricate in Man, and that the seminal Fluid suffers a longer Remora. But the Epididymis is a small Body connected all along the gibbous Part of the Testicle, to which it is attached by a Membrane, by dividing which it may be separated from the Testicle. It begins at the obtuse End of the Testicle, and terminates where the Corpus Pyramidale arises up from the Testicle. After removing the Membranes, the whole Epididymis dissolves into Bundles, and by macerating in Water it unravels, so as to become twenty Times longer than at first. The Epididymis therefore is the excretory Duct of the Testicle variously contorted. It receives the third Branch of the spermatic Artery; but whether or no any Thing is separated into it from thence, I am not able to affirm, notwithstanding that seems probable. This excretory Duct is the Seat of dreadful Symptoms in venereal Disorders; for in this cold and intricate Passage the Virus is often retained, and hardly admits of a Cure.

³ Where the Epididymis terminates, there the Vas Deferens begins, and goes on to the Os Pubis, over which it ascends, climbing from thence thro' the Pelvis to the seminal Vesicles at the Neck of the Bladder. Hence we may understand, why a Wound inflicted upon the anterior Part of the Ossa Pubis may render a Man sterile, because, in that Case, these feminiferous Tubes must be necessarily divided; and from hence also we see why large Inflammations, Suppurations, or Tumors, at the Ossa Pubis, destroy or remove the procreative Faculty in Man.

⁴ In the Ossa Pubis there are two small Notches or Excavations observable in the Skeleton, through which the Vessels pass to and from the Testicle.

§. 646. This Fabric of the Epididymis is in Part made up with small Nerves coming from the Plexus of the Abdomen, and spread together with small Vessels from the Spermaties upon the nervous Tunic, from whence they afterwards disappear; and to these add another Branch of Nerves, coming from the *twenty-first Pair*¹ of the spinal Nerves.

¹ These last Nerves were first added by *De Graaf*, before the finding of *Eustachius's* Tables, in which they had been long before figured; though till his Time Anatomists derived the Nerves of the Testicles only from the Bottom of the abdominal Plexus; but yet there were some of the Ancients suspected there were other Nerves sent from the Brain to the Testicles; more especially, because *Hippocrates* had pronounced concerning the effeminate *Scythians*, that there were some Nerves ran behind the Ears, which, being cauterized, destroyed the Power of Generation: But, upon accurate Enquiry, they could find no such Nerves. Now these Nerves enter the Testicle, together with its Vessels, in the same Manner as in the Heart; for the Testicle, like the Heart, is suspended freely in its Capsule. From these Nerves proceeds the great Sensibility of the Testicles; for we have seen fierce Bulls who have fainted away by pinching the Testicles.

§. 647. The Testicle has also very small *Veins*¹, and an infinite Number of *lymphatic*² *Vessels*, which return back that Humour which remains after the Secretion has been made; and it is also *probable*³, that from those Vessels in which the Semen is prepared, and yet not evacuated,

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cuated, a large Part thereof, which is the most subtil, may be absorbed by these Vessels in the Corpus Pyramidale, from whence mixing with the renal Blood, it may be sent throughout and produce a Change all over the Body.

¹ These small Veins are of two Kinds, the one corresponding to the Arteries, which seem to arise from the exterior Membrane of the Testicle, the Epididymis and internal membranous Partitions; and these are the Veins which are filled by injecting the spermatic Vein, by forcing the Wax downward, as is sometimes done without Difficulty, because in some Subjects these Veins are destitute of Valves: And by injecting these therefore some of the Veins may be filled which are spread upon the Membranes and internal Substance of the Testicle.

² The second kind of Veins are the Lymphatics. When a Testicle is denudated, and affords no Appearance of lymphatic Vessels, if then the Testicle is macerated for twenty-four Hours in warm Water, the whole Corpus Pyramidale will then be turgid with lymphatic Vessels; which is a manifest Argument that many of the lymphatic Veins of the Testicle intermix themselves together with the Epididymis. Nor are the Lymphatics more numerous in any Part of the Body, as may be readily demonstrated in the Testicle of a Bull, or of a male Rabbit.

³ The Semen prepared in the Testicles in Animals which do not discharge it, seems to be absorbed by the Veins, by which returning into the pyramidal Body, it is afterwards sent throughout the whole Habit, wherein it produces those wonderful Changes which we experience. But when the Testicles are taken away from a Man in Health,
without

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without injuring any other Part of the Body, a great Alteration is produced throughout the whole Habit, the Beard falls off, his Voice becomes effeminate, the Passions of the Mind alter, &c. yet every Thing remains the same in the whole Body; the same Arteries and the same Veins, and nothing more is wanting but the Return of the seminal Humours into the Blood as before. Hence also we may derive those Changes which we commonly observe in the Body at the Time of Puberty, the Voice becoming two whole Octaves lower, the Hairs gradually thrusting themselves out, and the Inclinations of the Mind becoming more powerful, not upon the Account of Semen discharged from the Body, but from that Part of the seminal Fluid which is absorbed by the small Veins, and afterwards dispersed throughout the whole Habit. Add to this, that an Injection thrown into the spermatic Veins penetrates into the seminal Vesicles, whence it is certain that the Semen must return and circulate, though very slowly. But it is also probable, that the Nerves penetrate the Substance of the Testicle in such a Manner, as to pour out their Juice into the seminal Humour secreted from the Arteries, in order to mature the same, and render it prolific.

§. 648. The seminal *Vesicles* ¹ connected by Membranes to the back Part of the Neck of the Bladder, are folded together, like blind Intestines, into Turnings, Windings, and Cavities or Cells, in which *terminate the Vas Deferens* ², which becoming gradually broader and more hollow, and again contracting or becoming more narrow, is then incurvated at its Entrance into the Abdomen; from whence it passes almost in a di-

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direct Course to the capacious Bottom of the seminal Vesicle into which it is inserted: But from hence again another excretory Canal is sent from each Vesicle, joined at acute Angles with the former; both which Emissories meet together in the Urethra at an obtuse Angle, and terminate in one excretory *Canal*¹, opening into the Urethra. By this middle and single Opening is placed betwixt two other lesser ones, which are higher, and placed opposite to each other on either Side; so that thus the seminal Humour is expelled through three distinct Openings, and in the mean Time the two several Vesicles are compressed and conjoined by a muscular Membrane.

¹ It is not common for all Animals in general to be provided with seminal Vesicles, since there are some of the largest of them have none. But Man is always furnished with them, and has them larger than any other Animal. Their Fabric is such as enables them to receive and retain a large Quantity of Semen, and not to discharge it immediately, but to render it more perfect; so that the Semen is never evacuated in the human Body without first exciting the venereal Pleasure. I have not found one Exception to this during the many Years in which I have addicted myself to the Cure of Diseases; for even in Dreams there is an Erection and Sense, as when the Man is awake. But that Humour which is often discharged and taken for Semen in the Urine, is separated in the prostate Gland.

² The Semen which is sent into the Vesicles, is first formed and prepared in the Testicles. The
Nerves

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Nerves and those Arteries which do not terminate in Veins, deposit their Humours within the Cells of the Testicles, where it is elaborated or matured, and afterwards pressed from thence into the Epididymis by the cremaster Muscle, and the Pulsation of the Arteries spread upon the exterior Tunic of the Testicle; to which add the Protrusion from the Semen flowing behind, whence the Cells are filled, and the Semen conveyed into the Ductus *Highbori*. If these Causes are absent, a great Part of the Semen will be absorbed by the Veins, and returned throughout the whole Body; but that which enters the Corpus *Highbori*, passes from thence into the Epididymis, or that long convoluted Canal placed at the smaller End of the Testicle. Nor is the Epididymis a mere Canal, since when it is divided even in a dead Body by an horizontal Incision through the Testicle, it appears to be a Canal as thick as the Urethra, and encompassed externally with a fungous Substance, as *Lewenboeck* observes to me in his latter Epistles. Since therefore this Canal has so many Inflexions, it must give a great Resistance to the contained Humour, which will be therefore retarded, and be in some measure altered, by the Fabric of the spongy Substance, being like that in the Urethra; and then it will be protruded into the Vas Deferens, which is likewise invested with a spongy, fleshy Substance; but it is derived from the Epididymis, behind which ascending out of the Scrotum, it reaches the Os Pubis; over which being incurvated, it descends behind the Bladder, and terminates in the seminal Vesicles. These Vesicles are narrow near their Insertion at the Urethra, but become broader and larger, as they recede farther back and towards each Side from the Neck of the Bladder. The Semen therefore coming out of a

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small Canal into a larger Receptacle will stagnate; but to prevent it from returning back too easily, the Receptacle is furnished with inflected Partitions, by which it is divided, as it were, into so many Cells, communicating, as it were, with each other. But *Wharton* observes, that the Cells of the seminal Vesicles are not altogether such mere Membranes, but that they have the cellular Substance spread round them. Thus the Semen separated of an ash Colour in the Testicle is more elaborated in the Epididymis, and is afterwards still farther matured in the Vesicles till it is become perfectly white. For in the human Testicle, as also in that of the Ram, the seminal Liquor is much thinner, and more of an ash Colour than that in the Epididymis; in which last it is perfected as if it were by Incubation, till it is at last become white and thick in the Vesicles.

³ This is the only way by which the Semen can discharge itself out of the Body, namely, by one large Emissory in the Caput Gallinaginis, and two smaller Openings placed on each Side the fore-mentioned Caruncle, or Caput Gallinaginis.

§. 649. From all that has been said (§. 641. to 649.) it is evident, that a *small Quantity*¹ of Blood, like that of the *emulgent Artery*², being received by the spermatic, and moved on *slowly*³, is retarded about the *Corpus Pyramidale*⁴, where the grosser red *Parts*⁵ of the red Blood are transmitted into the Veins by open Anastomoses; whence again the Blood of the remaining Artery becomes less red, moves on more slowly, so as almost to stagnate, of an ash Colour, in the narrow Gyri and Re-cesses

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cesses of the Testicles; from thence being deposited and *thickened* ⁷ in the *Highmorian Ducts* ⁸, it is very slowly propelled into the Epididymis, within whose Convolutions it is again digested, stopped, and elaborated. After this it creeps on into the Vas Deferens, which is at first thick, very narrow, and invested with a spongy Substance, but gradually enlarging, till it is become very *capacious* ⁹ and hollow, it then again is more contracted; so that here again the Semen is collected, stopped, digested, and elaborated, in the Dilatations, Sinuosities, and Recesses, of this Vessel; and at last it is propelled into the winding Cells of the broad seminal Vesicles; where being repositied, it stagnates, thickens, becomes whiter, more digested, and elaborated to the highest Perfection, which we call Semen.

¹ That this Portion of the Blood is small, appears, 1. From the Smalness of the Artery. 2. From its lateral Anastomoses with the Veins. And, 3. From the lateral Branches distributed to the Tunica Vaginalis and adjacent cellular Membrane, which draw off a large Part of the seminal Blood.

² Why Nature should chuse to make Use of the urinous Blood, derived hardly an Inch distant from that of the emulgent Arteries, for the Formation of the Semen; and why she has placed the seminal Vesicles so near to the Bladder, we are as yet ignorant.

³ The Slowness of its Motion is evident from the Smalness of the Artery, and the Manner in which it arises from the Aorta.

For

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⁴ For here the spermatic Artery is inflected.

⁵ Little or none of the red Blood, as is evident from Injections. For when almost all the other Parts of the Body have been happily filled with Wax, so as to distend not only those Vessels which contain Blood in a healthy Man, but also those which do not, in the Cornea, Retina, Cortex of the Brain, &c. we nevertheless do not find the Injection to have penetrated so successfully into the Testicles; though it would seem that if they contained Vessels large enough to receive the red Blood, we should find them also filled by the seminal Arteries. But even to the present Day we have been able to inject only a few arterial Branches spread upon the membranous Partitions of the Testicle; and therefore from hence I infer, that not the red Blood, but only its thinner Part destitute of Colour, pervades the smallest Arteries of the Testicle.

⁶ In the Testicles of Dogs, Dormice, and other Animals, are demonstrated a great Number of seminal Arteries, which being spread upon the Cells, form the spongy Fabric of the Testicle, into which they deposit their contained Humours. But in Man the Nature of the Testicle is different from that of Brutes, since all its Vessels are much smaller; nor has any Animal so minute and tender a Fabric of their Testicles. In this indeed they agree, that in all the Semen is moved on very slowly; and this therefore seems to be the Reason why Nature has placed the Testicles without the human Body, and made them subject to no other Motion than that of the thin cremaster Muscle.

⁷ Like unto the White of an Egg. This exceeds in Thickness all the other Humours of the Body, the Blood, Serum, Mucus, Adeps, Bile, and even the Mucilage of the Joints; for the best

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Semen which has been a long Time retained in the seminal Vessels, is thicker than either of these.

⁸ These *Higlmorian* Ducts are not demonstrable in the human Testicle by reason of its minute Fabric; but in Brutes the Cells all empty into a Canal fixed upon the Back of the Testicle under the Epididymis, betwixt the Tunica Albuginea; which Canal, after repeated Inflexions, terminates in the Epididymis. In Man the Epididymis arises as in Brutes, but it receives a greater Number of Canals; which renders it probable, that there are more *Higlmorian* Ducts to convey the Semen from the Cells into the Epididymis.

⁹ Exceeding broad, if compared with the narrow Vas Deferens; whence the Semen must, consequently, stagnate in these Receptacles, and be retained for a long Time; but it is not only retained, for some Part is carried away by the absorbing Vessels, while the Remainder is further elaborated. The seminal Fluid, thus arrived into the Vesicles, is then first denominated Semen. It has been often enquired, but never yet demonstrated, Whether the Semen of the Testicles be prolific? For if it is, what Need of the Epididymis to receive the Semen from the Testicle after it is once formed? Again, if it be asked, Whether the Semen be prolific before it has entered the seminal Vesicles? Whether it is not changed and perfected by the small Vessels of the Vesicles? At least it seems probable, that in this Place the Semen receives some Change towards the Production of our Species.

§. 650. From what has been said, it appears, that no animal Humour is secreted so slowly, meets with so many *Retardations* by the way, or is thus so greatly digested by Rest. But there may perhaps be always some
Ad-

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Addition made to the Semen in its Course by the smallest nervous, and other Vessels; but this yet remains a Question. It is also probable, that some of the more fluid Parts of this Humour are *absorbed*² by the Lymphatics, and sent to the Veins of the Corpus Pyramidale, or to the Veins of the seminal Vesicles; and by them again returned into the Mass of Blood throughout the *whole Body*³.

¹ Nor is there any Humour generated so slowly, unless some Violence be offered to Nature; and then the whole Body would be soon exhausted: For all the other Humours, after Secretion, pass directly to those Parts through which they are discharged; but the Semen first undertakes a long Course, and is so much retarded by the way, as to be almost inclined to Putrefaction.

² All these Parts thro' which the Semen takes its Course, are pervaded by small Arteries and Veins; whence some of the more fluid Part of the seminal Liquor is taken up by the Veins, and some Addition made by the Arteries every Moment.

³ In these Parts the Veins are more numerous in Proportion to the Arteries, than in any other Part of the Body. The Corpus Pyramidale is made up entirely of Veins, and is fifty Times larger than the seminal Artery; but every Vein composing that Body, is larger than the whole seminal Artery from whence all those fifty Veins arise. The Testicle likewise seems to labour for the whole Body, to maintain the masculine Habit. If indeed the Veins were no more in Proportion than the Arteries, one might believe that the Semen separated from the Arteries did not return by the Veins; but as the Veins are fifty

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Times larger than the Arteries, it seems reasonable to suppose, that they convey back much more than the little Blood remaining after the Secretion; and thence it follows, that though the Testicle is designed for the Propagation of the Species, yet a great Part of the seminal Fluid prepared in the Testicle, is returned into the Mass of Blood for preserving the Individuum in a healthy State.

§. 651. The seminal *Liquor* ¹ found in the medullary Part of the Testicle in the Epididymis, Vas Deferens, and seminal Vesicles, being diluted soon after Death with *warm Water* ², and viewed by the best Microscopes, appears to contain innumerable small living Animalcules, of an oblong Figure, with a Tail, like Eels, swimming up and down in the Liquor; and this holds true, not only in Man, but in Quadrupeds, Birds, Fish, Insects, and amphibious Animals; but this *only* ³ with respect to the Humour of these Parts. If this be compared with the Bulk, Figure, Place, and Changes, suffered by the *Carina* ⁴ of the Chick, as described by *Malpighi*; and if we compare it with the Course Nature observes in the Generation of *Frogs* ⁵, it will appear probable, that these Animalcules of the male Semen contain the future Rudiments of the whole Body; more especially since the Testicles, or their seminal Humour, being absent, always occasion Sterility on the Part of the Male. When these Animalcules are received into a fit Place or Nidus, and there supplied with most subtil Nourishment, forwarded by a friendly Warmth

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and Motion, they grow up and unfold themselves, so as to display the latent Parts, of which they are composed, even to the naked Eye; in the same Manner as the Eggs of Birds, Insects, Tortoises, and Vegetables, remain inactive for many Days, Months, or Years, and yet continue prolific till Length of Time adds the before-mentioned Conditions, and excites the unactive Principle of Life.

These Animalcules have been admitted by all the Moderns, who have been able to see with their Eyes by the Assistance of Microscopes. Even the Controversy which subsisted betwixt *Hartsoecker* and *Lewenboeck*, concerning the Origin of the Discovery, is no small Confirmation of the Truth of the Experiment. I desired of *Lewenboeck* to determine plainly by his Glasses, in what Part of the Testicle the seminal Animalcules first appeared. The Result of his Observations was, that the Blood, the Serum of the Blood, Urine, Liquor of the Ventricles of the Brain, Contents of the spermatic Artery or Vein, neither of them contained any Animalcules: But that these Animalcules were to be found in the seminal Fluid contained in the Cells of the Testicle, in *Higmore's* Duct throughout the whole Testicle, the whole Epididymis, and the whole Vas Deferens, together with the seminal Vesicles; and lastly, in the Semen discharged by a Fit of Venery from a living healthy Man, or other Animal. But those Animalcules sometimes found in the Teeth, arise from the Access of the Air; whereas we are now enquiring concerning Animalcules which live where the external Air has no Access; but from

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whence these seminal Animalcules are first derived, we are perfectly ignorant.

² If the Semen be diluted with Water Blood-warm, and afterwards placed upon a Bit of *Muscovite* Talc under a good Microscope, you will, by that means, see the living Animalcules moving themselves about like Eels, of an oblong Figure with a roundish Head, and swimming in the rest of the Liquor which is not made up of Animalcules. The Semen then is composed of two Parts; the one an Assemblage of Animalcules, which live a considerable Time after the Death of the Animal; the other, a thick balsamick Humour, almost without Motion, serving as a Vehicle to the Animalcules.

³ The Liquor of the prostate Gland does not contain Animalcules, and yet good Semen is not formed when these Parts are corroded; so that the chief Use of the Testicle seems to be for the Formation of these Animalcules. *Lewenboeck* demonstrates in his latter Epistles, that he cannot discern any Animalcules in the Ovaria of Females and oviparous Animals: It now remains for us to examine, whether it is probable that these Animalcules are the human Species in Miniature, requiring only to be expanded or enlarged to become one of ourselves. Certain it is, that Fœcundity depends upon these Animalcules, since no male Animal was ever known to generate after a Loss of the Testicles. *Aristotle* indeed writes, that Bulls, after Castration, have sometimes fœcundated Cows; but then he adds, that this happens but once, and only a few Days after Castration, there being a sufficient Quantity of Semen then residing in the Vessels, for one Impregnation; but that Semen being exhausted, they are ever after sterile; whence it follows, that the Testicles only are the Cause of Impregnation.

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⁴ If the Testicles and Vesiculæ Seminales of a Cock be taken out and examined by the Microscope, they will appear filled with Animalcules. When the Hens have been kept for some Months from associating with a Cock, the Eggs which they lay consisting only of the Shell, two Membranes, Albumen, and Yolk, are not immediately employed towards Generation. But in the Center of the Yolk of this Egg we find, according to the Observation of *Du Verney*, towards the obtuse Angle of the Egg, a kind of Placenta or Sacculus, containing a small Drop of a pellucid high-flavoured Liquor, which is a kind of Uterus, wherein, like the Amnios, the Chick is included and nourished by a gradual Attenuation of the Albumen, which is elaborated and daily changed thro' the small Vessels of this Placenta, till it is, at length, wholly consumed. If now this Sacculus be carefully taken out entire, by viewing with a Microscope, we perceive it contains something of a confused Mass of a high Relish. If now this Egg is placed under the Hen, it will putrefy by Incubation, the Sacculus and its Contents will disappear and exhale together, with the putrid Humours, through the Shell, which will be left empty or full of Air, whence they take the Denomination of Wind-eggs. But now let us examine the Eggs which have been laid by the Hen associating with the Cock: Such a Hen does not receive any Thing from the Cock at the Time of Impregnation, more than the Animalcula contained in the Semen; and yet if thirty of these Eggs, being orderly numbered or marked, are placed under a sitting Hen, upon opening one of them an Hour or two after, we may observe, by the Microscope, a kind of small Animalcule, or Carina, residing in the Sacculus of Colliquamentum. Of this we have a

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faithful History given us by *Malpighi*, with great Accuracy. If, again, the second Egg be opened after two Hours more, the oblong Carina, or incipient Chick, will appear more distinct, and will be still more evident in the third Egg opened six Hours after Incubation; and thus will the Animalcule appear more and more manifest by Degrees, until the twenty-first Day, when we find a living Chick confined within the Shell and Sacculus of Colliquamentum. Hence it follows, that the two-legged and winged Chick was formerly an oblong Vermicle, which, by Degrees, advancing through various Changes, assumed the Shape of a compleat Animal. But the Carina or incipient Chick having no Appearance of Legs and Wings, very exactly resembles a Vermicle; and even the incipient human Foetus, as delineated by *Ruyfch*, appears in the same Figure.

⁵ In the warm Spring at Noon, Frogs are found breeding in Ditches in great Numbers; and we then observe a Mucilage floating in the Water without dissolving, which is falsely termed the Spawn of Frogs: But in this Mucilage we perceive an infinite Number of small black Points, which are truly the Eggs of Frogs. If you expose some of this Mucilage in a glass Vessel to the Warmth of the Sun, and inspect the same by the Microscope, you will perceive, that each black Point is a true Ovum, including a small Vermicle folded together, without Arms or Legs, much resembling a little Eel. As this Animalcule advances in Growth, the posterior Limbs are gradually formed, and then the anterior, while the long Tail continually shrinks up; till, within the Compass of a few Days, it appears in the Form of a Quadruped, or young Frog. So true is it, that every Animal is a Fish at its first Formation,
that

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that the same does not admit of Exception, even in all Reptiles, and the several Classes of Butterflies. Hence, then, the Origin of our Species appears evidently to be lodged in the Male; but that the Place for its Reception, and the Matter for its Nutrition, are supplied by the Female for a certain Time until it is compleated. There are even numerous Pores in the hard Shell of a Hen Egg, through which some of the Vapours of the sitting Hen insinuate themselves, and increase the Foetus, so that the Chick, when perfect, greatly exceeds the Weight of the Egg, from whence it was formed, as *Bellini* testifies. But somebody may ask, Why are not the Vermicles nourished within the Male? No one will propose this Question, without supposing ourselves acquainted with the Nature and Fitness of Things agreeable to the Design of their Creator, which we are not. Let such a Querist answer me how the Eggs of Caterpillars are not destroyed by the most severe Winter. Throughout all Nature, the Seeds or Ova of organic Bodies, require a certain Time, within which the Foetus is maturated or brought to Perfection. Thus in the Seeds of Plants we observe, that they sow themselves towards the Winter, and, after lying buried for several Months, they at length sprout up in the next approaching Spring. *Helmont* has therefore well defined Nature to be a Creature executing the Will of the Creator.

§. 652. Round that Part of the Urethra, into which the seminal Vesicles *open*¹, is seated the prostate Gland, but one in Number, continuous, conical, and invested with muscular Fibres, yet composed of twelve distinct smaller

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smaller Glands, assembled and united together in such a Manner, that each aggregate Glandule terminates, by its particular Emissary, into one corresponding Sacculus, receiving the secreted Humour; so that there are twelve distinct Sacculi, and as many considerable excretory Ducts opening into the Cavity of the Urethra, around the Opening of the seminal Vesicles. Hence it follows, that the Semen and Humour of the prostate Gland are here intimately mixed together in the Urethra; more especially as the seminal Vesicles and Glandulæ Prostatæ are encompassed by the same muscular Membrane.

* In Man, the seminal Vesicles are fixed to the Neck of the Bladder, whence there must be some Reason, why Nature has so nearly linked together the Seat of the Urine and Semen already formed. In the next Place, the Semen is evacuated into that Part of the Urethra, which is encompassed with the excretory Ducts of the prostate Gland, which discharges its secreted Juice by twenty-four small Orifices into the Urethra at the Time when the Semen is ejected; six of these excretory Orifices being placed before the three Apertures through which the Semen is emitted, six of them behind those Apertures, and six on each Side. Hence the Semen is never evacuated, but when the Liquor of the prostate Gland goes before, and follows after, to which it must be, doubtless, of considerable Use. This Gland has been the most accurately described by *Littre, Mem. Acad. Ann.* 1700.

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§. 653. This Humour, formed by the prostate Gland, is mild or balsamic, somewhat oily, white, and secreted plentifully, being *oftentimes*¹ expressed in discharging the Urine or intestinal Fæces, when a Person has long abstained from Venery; it does not contain any of the Animalcules before described, yet its Action continues after the Testicles and seminal Vesicles have been taken away, but is not then in the least prolific; hence it seems to be a Vehicle to convey and *dilute*² the thick and Ash-coloured Semen, and may, perhaps, serve to nourish the forementioned Animalcules during the first Moments of Procreation.

¹ Even the most healthy Men, who have long abstained from Venery, often observe, that after the last Drops of their Urine are evacuated by constringing the Urethra, and after violent straining upon the Stool, there is something of a mucous Consistence discharged with the last Drop or two of the Urine, and which appears thick and white, without any Manner of Malignity. This is what happens to all Men, though chaste and in Health; but more especially does it happen in a greater Degree to those who, having run upon the Rocks of venereal Disorders, are by them rendered more cautious and abstemious for the future. I have been an hundred Times consulted on this Account by Men who have suspected themselves troubled with a Gonorrhæa; but this is a Disorder purely natural, and to which the most healthy are liable, at one Time or another. This Humour flows not from the seminal Vesicles, but from the prostate

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prostate Gland only, and it distils slowly without any Ejaculation, contrary to the Semen from which it differs. Hence we observe, that this Humour is not wanting in Eunuchs when they have an Erection; and the same Liquor sometimes distils from Geldings when they strive to Leap. This Circumstance having been observed by jealous Mortals, namely, that Eunuchs discharge something which had the Appearance of Semen, although they were castrated, they thought themselves still in Danger; for which Reason, according to *Solimanus*, was enacted that Law, which is still observed at the *Turkish* Court, namely, to admit only such Eunuchs to the Custody of the Women, as have had the Penis amputated at its Root. But this Liquor, which appears like Semen in castrated Animals, is absolutely unprolific and destitute of the before mentioned Animalcules. So much appears from the last Experiments of *Lewenboeck*, when, at my Request, he enquired into the Seat of the genital Vermicles.

² Healthy Males continually separate Semen, which being retained and inspissated like the white of an Egg or Starch, would be almost immovable, if it were not for the more thin Juice of the prostate Gland, which serves to lubricate the Urethra almost like an Oil. Besides this, as the Animalcule must stay a long Time before it arrives in the Uterus, it seems necessary for it to be provided with a suitable Aliment; for unless Nature nourished the Animalcule when formed, it would certainly become extinct: But this nutritious Liquor seems to be that of the prostate Gland, which in some Animals is larger than the Testicles themselves.

§. 654. The *Urethra* ¹ is made up of *two* ² Membranes, betwixt which is interposed a *Corpus Cavernosum* ³ or spongy Substance, which is thickest about the End of the prostate Gland, where the Corpora Cavernosa Majora unite together; and from thence diminishing all along, it at length becomes thicker, and is expanded over the End of the Penis, so as to form the Glans, leaving a small Aperture in the Middle, and being so inflected upward, it constitutes the spongy, soft, and external Surface of the Glans, and terminates in a protuberant Rim, all round which the Prepuce is connected. Within the Cavity of this Tube, the Urethra, *open* ⁴ oblique excretory Ducts coming from the mucous Glands of Cowper; from whence they convey a balsamic or mucous Liquor, more especially when the spongy Substance of the Urethra is flaccid, in order to lubricate and defend its interior Surface; and besides these there are many more larger and smaller excretory Orifices, which are the Extremities of small Ducts, coming from beneath the interior Membrane of the Urethra, and discharging a like mucous Liquor for lubricating the Passages and preventing them from growing together. The spongy Substance of the Urethra which forms the Glans, is covered externally with an exceeding thin Membrane or Cuticle, under which are placed the very sensible nervous Papillæ, which are the chief Seat and Cause of Pleasure and Pain in this Part; but

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but under the forementioned very thin Membrane or Cuticle is placed a wonderful *cellular Fabric*.

¹ The Urethra is a Canal arising from the Neck of the Bladder under the accelerator Muscles, and from thence extended to the Glans; whence it happens, that when a Stone is impacted in the Neck of the Bladder, the Sense thereof is represented to the Mind as if something irritated the Glans.

² The internal Membrane of the Bladder is extremely sensible, as we are convinced by severe Experience in a Strangury, Stone, or an Ulcer of the Bladder. But the Membrane of the Urethra, thus continued from the internal Membrane of the Bladder, is not so extremely sensible; its Surface being covered over with a spongy Substance, in that Part where the Bulb of the Urethra is seated; and outwardly is spread another Membrane which confines the cellular Fabric, so that the spongy Body of the Urethra is confined betwixt two Membranes.

³ The Corpus Cavernosum of the Urethra is thickest betwixt the prostate Gland and Corpora Cavernosa Penis; for the Urethra goes on for the Length of two Fingers Breadth from the Bladder, before it reaches the Body of the Penis, and during that Space the Urethra is encompassed with the prostate Gland; in that Part therefore where the Urethra joins the prostate Gland, its Cavity is largest, and spongy Substance the thickest, upon which Account, it is by *Cowper* termed the Bulb of the Urethra, in his accurate Description of the human Penis. From thence the Urethra goes forward, becomes narrower, till having reached the Glans, the internal Tunic is quite absent, and the spongy Substance departs from it, while the external

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ternal very thin Membrane like the Cuticle is spread over the Glans, which is formed by the spongy Body of the Urethra, reflected and spread over the Ends of the Corpora Cavernosa Penis; so that the Glans is no more than a Continuation or Expansion of the cavernous Substance of the Urethra. Hence it is evident, why the Glans Penis is sometimes eat away in venereal Disorders without injuring the rest of the Penis? For the Glans appears to be really Part of the cavernous Substance of the Urethra, which is the first Seat of a virulent Gonorrhæa; so that the Urethra being corroded or eat through, the Glans Penis, which is a Continuation thereof, must necessarily mortify or fall off, especially in its anterior and upper Part, while its posterior and lower Parts remain entire; because they are made chiefly by the cavernous Bodies of the Penis, which being invested with their proper Membrane, are secured from the spreading Putrefaction.

⁴ Into the Urethra open first the three Orifices of the seminal Vesicles (§. 648.), in the posterior and back Part thereof. Secondly, The twelve Mouths of the Ducts belonging to the prostate Gland. Thirdly, Two large Orifices of *Cowper's* Ducts. Fourthly, Throughout its whole Length open the Ducts of *Morgagni's* smaller Glands; whence it follows, that the whole internal Surface of the Urethra is perfected like a Sieve. The first Seat therefore of a Gonorrhæa is in the small Glands of *Morgagni*, especially those larger Ducts seated about an Inch within the Glans, by pressing which a good deal of Matter follows. A second and worse Species of the Gonorrhæa is seated in the mucous Glands of *Cowper*. The third and still worse Species extends to the Insertion or Opening of the Ducts of the prostate Glands and seminal Vesicles. The fourth Species, which is hardly curable, affects the

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the Bulb of the Urethra round the Neck of the Bladder, terminating in phagedenic Ulcers.—The Urethra before described has three Dilatations, the first of which lies betwixt the Bladder and cavernous Bodies of the Penis, and is immediately followed with a Contraction or Narrowness like a Sphincter; and it is into this first Cavity that the Semen is first poured, collected, and mixed with the Juice of the prostate Gland, a little before it is ejected with a convulsive Force. After this Cavity the Urethra is contracted, whence a Calculus slipping through the Neck of the Bladder is often stopped in this first Cavity, directly under the Os Pubis. From thence the Urethra ascends a little, and unites with the suspensory Ligament of the Penis, which was revived by *Cowper* after being forgot; and here again the Urethra is a little dilated under the Os Pubis itself, so as to form the second Cavity or Dilatation. But from thence continuing on with the Penis, it is rendered narrower, enlarging itself afterwards as it advances farther towards the Glans, till it is at last contracted again at its ultimate Extremity or Orifice in the Glans. From hence we learn in what Parts of the Urethra small Stones are stopped, and excite Pain; namely, in coming from the larger Dilatations towards the narrower or more contracted Parts of the Urethra. Hence it is also, that the first Species of a Gonorrhæa only affects the pendulous Part of the Penis from the Os Pubis, being more easily curable than the rest.—The Glands of *Cowper* insinuate their oblique Ducts over the cavernous Body of the Penis into the Urethra; and hitherto a Gonorrhæa extends, when it has penetrated through and destroyed the Glans; but, in this Case, the Penis is generally eroded outwards, and the Urine discharges itself through an incurable Fistula, which the Patient is obliged to sustain for many Years. The

§. 654. *Origin of the Male Semen.* 81

The Nature of this cellular Membrane or Substance was first demonstrated by *Ruysch*, and is extremely necessary to be understood, in order to the Cure of Diseases in this Part. This cellular Substance interposed betwixt the Cuticle and cavernous Substance of the Glands, may be inflated to the Thickness of a Finger, being continued to the dartos Muscle, causing the Penis to be tense; different from the thin loose cellular Membrane, which lies immediately under the true Skin of the Penis itself.—From what has been said, it is evident, why the very thin Membrane of the Glands being eroded, a venereal Ulcer may creep betwixt the two Membranes of the Urethra even to the Neck of the Bladder, as I once knew in a certain Nobleman, well known throughout *Europe*. For the spongy Substance of the Urethra being continuous with the Glands, its tender Fabric may be destroyed without corroding the Membranes. Hence also appears the Reason of a Chordee in that Disorder, namely, a painful and partial Distension of the Penis, when the cavernous Body of the Urethra is distended, while the rest of the Penis continues flaccid; and why, in a Disease which seldom happens and is but little known, the Urethra and Glands only are distended, while the cavernous Bodies of the Penis continue flaccid, whence follows Sterility, because the Semen is not conveyed to the Uterus with due Force. For as the Corpus Cavernosum of the Urethra is perfectly like a Sponge, and distended, in an Erection, like the cavernous Bodies of the Penis; if that be distended alone, the Semen cannot be evacuated with a sufficient Force. Secondly, From this Discovery of *Ruysch* we may understand why many, in the venereal Act, have not the Glans distended, tho' the whole Penis is, at the same Time, turgid;

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namely,

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namely, because the Glans belongs entirely to the cavernous Body of the Urethra. And *Ruysch* has demonstrated, that in the *Orgasmus Venereus*, the Moment before the Semen is ejected, the Glans and whole cavernous Body of the Urethra are extremely turgid, so as to be ready to burst, but soon after a Convulsion follows, and the Semen is discharged with a considerable Loss of Strength throughout the whole Body; but in some People the *Corpus Cavernosum* is not distended, whence Impotency, which not being easily understood, cannot be cured by any Physician.

§. 655. The *Corpora Cavernosa Penis* arising separately from the lower and anterior Part of the *Ossa Pubis*, each invested with its proper Membrane, are *joined*¹ together afterwards by a *Septum*² or middle Partition, which gradually disappears forward, where they make up the principal Part of the Penis, which growing gradually less under the *Corona Glandis*, and composing the interior Substance of the Glans, does there terminate; the whole Body of the Penis thus formed of the *Corpora Cavernosa*, is invested with a cellular Membrane of a wonderful Fabric, which likewise encompasses the *Septum Medium*; next to this lies a firm, nervous Integument, limiting the Bounds of its Extension; and, lastly, it is covered with the Skin and Cuticle.

¹ The *Corpora Cavernosa* gradually converge together from the *Ossa Pubis*, and unite together in their upper Part, leaving a Vacuity below for
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§. 656. *Origin of the Male Semen.* 83

the Reception of the Urethra, which is contained betwixt them, after having passed by itself from the Bladder for the Space of about four Fingers Breadth; thus the Urethra being continued forward with the cavernous Bodies above, they make up the principal Part of the Penis, terminating in an obtuse Point at the Frenum or Beginning of the Glands. The Substance of the cavernous Bodies is like the spongy Substance of the Urethra, being like that included betwixt two Membranes. Without these Corpora Cavernosa, the Penis would not be sufficiently strong and thick, and the Tube of the Urethra would be likewise too unequal.

² The Corpora Cavernosa have a Communication through this Septum, so that by distending one, the Flatus passes into the other.

§. 656. The Arteries of the Penis derived from the internal Iliacs, for the most part, convey their Blood into the cavernous Bodies of the Penis and Urethra, where dividing into an infinite Number of capillary Arteries, they terminate in corresponding small Veins; but amongst these, there are an infinite Number of hollow *Cells*, communicating with each other, and all discharging themselves into the large and single Vein running along the Back of the Penis, under the Ligament connecting the *Ossa Pubis*; but afterwards dividing itself into two Branches near the prostate Gland, they discharge their Blood into the internal iliac Veins on each Side; but the Veins of the *Corpus Cavernosum Urethrae* pass under the accelerator Muscles for a necessary Purpose.

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Into these Cells the Blood is poured when the Veins are compressed, the Arteries not being capable of the same Compressure; so that, in this Case, a true Inflammation follows; which, if continued for a long Time, may cause a Mortification, so as to make the whole Penis fall off by a Gangrene, which *Aritæus* describes as no uncommon Accident in a Satyriasis; namely, when Tumors are formed compressing the two iliacal Veins, and that of the Prepuce running along the Back of the Penis. Such Tumors sometimes are formed in venereal Disorders, not without Danger of a Gangrene; but a Physician skilled in the Fabric of the Parts, will open these Veins to evacuate some of their stagnant Blood, and make Room for more healthy Blood. It was said before, in what Manner the cavernous Bodies of the Penis are by Degrees distended by a Retention of the Blood, which is poured into them; but, in the mean Time, the Glans remains flaccid; nor does it become distended, before the cavernous Body of the Urethra is filled. Hence, when only one of the cavernous Bodies is duly filled, the Penis will then be incurvated to that Side; which is an incurable Disorder, as resulting from an Error in the Fabric of the Parts, not to be restored by any Artifice: When both the cavernous Bodies of the Penis are turgid, and the Glans remains flaccid, the Semen will not be then evacuated; but when the spongy Bodies, both of the Penis and Urethra, are rendered turgid at the same Time, the Erection is then perfect. But when the Penis is flaccid and pendulous, the Circulation from the Arteries into the Veins, is the same with that which happens throughout all the other Parts of the Body, namely, the Blood brought by the Arteries is continually returned by the Veins in the same Proportion. *Swammerdam*

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§. 657. *Origin of the Male Semen.* 85

first demonstrated, that the true Cause erecting the Penis was, the arterial Blood filling the three cavernous Bodies. But it may be asked, Why the Blood, brought by the Arteries, should be poured out into these cavernous Bodies, without being capable of returning by the Veins, whose Mouths, at that Time, must necessarily be dilated by the Expansion of the cavernous Bodies? We are therefore, in the next Place, to consider the Muscles which perform this, and which have no Share in the Office of expelling the Urine.

§. 657. If therefore, from any Cause, the animal Spirits flow from the Brain, more plentifully than usual, into the Nerves of the Muscles erecting the Penis (which might with Propriety be termed lecherous), as those Muscles *arise* ¹ from the external Protuberance of the Ischium below the Origin of the cavernous Bodies, and are inserted into the strong nervous Coat of those Bodies, in which they terminate tendinous, in that Case, the Beginnings of the cavernous Bodies will, by the Contraction of the Muscles, be pressed more powerfully against the Protuberances of the Offa Ischia, which will diminish the Capacity of their Veins; and the Body of the Penis itself being, at the same Time, pressed more powerfully against the Offa Pubis and their middle Ligament, by that means the large Vena Dorsalis will be more compressed, and the Veins of the Prepuce less: Thus, then, the Arteries and Veins will be filled; but the Veins being hence more compressed, the Ca-

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vities of the spongy Bodies will be filled from the same Cause; so that the two cavernous Bodies of the Penis, and that of the Urethra, as also the Glans, will be *inflated*², and rendered turgid on all Sides with Blood, especially the Moment before the Semen is ejected; that of the Glans following a considerable Time after the Erection of the Penis, whence the nervous Papillæ in the Crown of the Glans, being rendered *extremely tense*³, are by Attrition, soon after, affected so as to bring on a Convulsion of the Muscles which eject the Semen; but in this very Action the distending Causes are increased, whence the Penis becomes rigid, red, and erect; and in the mean Time, from the same Cause, the muscular Membrane of the prostate Gland and seminal Vesicles, and all the Nerves, will be put into a State of Tension; whence the Semen pressed out of the Vesicles, and the Liquor from the prostate Gland, will be collected together in that Part of the Urethra, which is not covered by the erector Muscles; and, in the mean Time, the transversalis Muscle (which arising from the external Tubercle of the Ischium is inserted into the upper Part of the Bulb of the Urethra), together with the *Dilatator Posticus*⁴, from the lower and anterior Part of the Rectum, to its Insertion into the lower and back Part of the Urethra, do each of them, at that Time, dilate this Cavity of the Urethra: And then, finally, the acceleratory Muscles (which arise fleshy from the upper Part of the Urethra

§. 657. *Origin of the Male Semen.* 87

thra under the Os Pubis, encompass the bulbous Part of the Urethra, and uniting together below, they depart from each other, and are inserted on each Side the strong Membrane of the Corpora Cavernosa Penis) being contracted or convulsed together with the Muscles of the prostate Gland and seminal Vesicles, while, at the same Time, the Blood is powerfully impelled into the Penis, the Glans is then extremely turgid, the spongy Body of the Urethra is greatly distended, even to Rigidity, and the *Papillæ*^s of the Glands being at the same Time irritated, the before mentioned convulsed Muscles eject the Semen, whereupon the Urethra becomes relaxed, the Flux of Spirits becomes less, the Veins are set at Liberty from their Compressure, and the Blood now flows into the relaxed Veins from the cavernous Bodies, whence all the extended Parts contract again, and the Penis becomes flaccid.

¹ These Muscles arise from the Tubercles of the Ischium, from whence they descend almost in a perpendicular Course to the Urethra, and are inserted firmly into the nervous Membrane, investing the cavernous Bodies. When these Muscles act, they compress the Veins, which return by the back Part of the Tubercle of the Ischium, by which means the Blood endeavouring to return from the Penis, is retained in its cavernous Bodies, is poured out into the Cells, and, by that means, distends the Corpora Cavernosa of the Penis and Urethra. But the same Veins being relaxed after the Muscles have been freed from their Convulsion, receive again the Blood by their open Mouths

from the Cells of the cavernous Bodies, which therefore become flaccid. Hence it is evident, why the cavernous Bodies of the Penis are so seldom affected in venereal Disorders; namely, because the spongy Body of the Urethra lies next to the Skin, and may be therefore easily infected; nor then can it easily communicate its Disorder to the cavernous Bodies of the Penis, betwixt which are interposed, not only the two Membranes of the Urethra, but also that strong Covering which invests the Corpora Cavernosa externally, all which Membranes must necessarily be eroded, before the Disorder can extend to the Substance of the Penis itself.

² This Change is altogether surprising. For if you compare the Penis, when flaccid, in a Horse, with the Condition of it when distended in a Fit of Venery, and, lastly, with the Condition of it after he has left the Mare, when it appears contracted almost to nothing; you must certainly own such a sudden Change to be very difficult to explain. To account for this, the Ancients taught, that the Penis was distended by Flatus, and that therefore a flatulent Aliment excites Venery; and upon these Figments they built their whole Theory, until *Swammerdam*, a Man born to promote natural Knowledge, taught us better. He put together a Dog and a Bitch, and, in the venereal Act, made a Ligature in an Instant upon the Penis, afterwards dividing it, so that the Root remained with the Dog, but the anterior Part was left in the Vagina of the Female: But in this anterior Part, both the Eye and its Weight demonstrated, that it did not contain Flatus but Blood, which violently discharging itself by the Wound, the whole Part contracted itself almost to nothing.

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³ When any nervous Part of the Body is slightly inflamed, it excites a kind of Pleasure, as is evident even in the Itch; but after the Nerves have suffered the greatest Degree of Pleasure, they are followed with a Convulsion, and that again is attended with a Relaxation. Thus in an Epilepsy, after frightful Motions, a Sleepiness, Relaxation of the Muscles, and a Snoring, follows, as if the Patient was in an Apoplexy. The same Thing happens in a Fit of Venery, in which the Semen cannot be ejected without a Convulsion of the Muscles; nor can the Muscles be convulsed without being afterwards relaxed, or rendered paralytic. This whole Action depends upon Muscles over which the Will has no Influence, either to suppress, excite, or diminish, their Action, as the Impotent experience to their Pain, when, being admitted to such Favours by their female Friends, they are incapable of Enjoyment. An abundance of good Semen, and the Company of a Woman, are the Causes which continually influence these Muscles to Action; whereas, if the Semen is absent, the latter will not be capable of exciting this Action. Lastly, If there is good Semen present, and the Man is in Health, if these Muscles are paralytic or weak, no Erection will follow, either from venereal Thoughts, handling, or any other Irritation. But neither are these Muscles to be reckoned among the Class of vital or spontaneous Muscles, since of themselves they do not act in the most healthy Man, but they are rather a Class *sui generis*, being under the Influence of the Imagination. The like Fabric takes Place also in the Clitoris of the Female, and its Muscles.

⁴ The Dilatator Posticus Muscle was first demonstrated by *Littre*. It arises from the Rectum, or rather its sphincter Muscle, and from this passes
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to the Urethra, which it therefore draws towards the Sphincter Ani. When the Muscles dilate the Urethra for the Reception of the Semen, just before it is ejected, then this Muscle of *Littre* acts together with the Accelerators, exerting a considerable Force to prevent the Semen from returning back.

^s When I first received a Penis prepared by *Ruyfch*, I was more than a little surpris'd at the Novelty of what I had not before seen; for the whole Glans was, by a secret Artifice, prepared so as to resemble the Back of a Hedge-Hog. I am not ignorant that there are some Animals having the Surface of the Glans villous, and beset with protuberant Corpuscles. I have indeed seen the Figure of the Penis with a Sort of Hooks, or crooked Villi, in the *African* Hare, by which the Glans is fastened to the Uterus: But who would have expected this Fabric in Man? *Ruyfch* having inflated the Penis, and suspended it in warm Water, afterwards took off the Cuticle of the Glans, by which means the Papillæ, before compressed and bound together by the incumbent Cuticle, were now loosened from each other, as we observe in the Lips, so that the whole Glans appears extremely full of Papillæ, which are then erected, distended, and irritated with a Sense of Itching, when the cavernous Body of the Urethra is very turgid, soon after which follows a Convulsion and an Evacuation of the Semen. This Fabric is necessary to be known, in order to the Cure of a new Disease, which I thought to be somewhat rare, when I first undertook the Practice of Physic; but I now find it more and more frequent. In this Disorder, the Head of the Penis is all over disfigured with Warts, which seem to arise from a Destruction of the Cuticle, by which

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which the Papillæ being set at Liberty and unconfined, grow up into Warts, which are true Productions or Processes of the Nerves.

§. 648. Hence therefore we may understand how far *Man*¹ contributes to Generation, and, what is *surprising*², why the Growth of the *Beard*³, with its *Preservation*⁴ and Hair of the Pubis, with the *Voice*⁵, Habit, and certain Passions of the Mind, accompany or *follow*⁶ the Formation of the Semen at a certain Age. But from hence we also know, that the Semen is of a very different Nature from the animal *Spirits*⁷, volatile oily *Salts*⁸, Ferments, or fermenting Humours, being a viscid, mild, or balsamic and unactive Humour; and it is also evident, that the *transverse*⁹ Muscles of the Penis, together with the *Accelerator*¹⁰ and *Dilatator Posticus*¹¹ of the Urethra, are of considerable Use, in dilating the back Part of the Urethra, which seems to have been hitherto hardly observed.

¹ Namely, that, agreeable to the Laws of Nature, the Embryo is formed in himself, and preserved floating in the feminal Vesicles; from whence the prolific Semen being evacuated through the Urethra by a convulsive Motion in the venereal Organs, at the same Time that the Juice of the prostate Gland mixes therewith in the Cavity of the Urethra, dilated by the transverse Muscles, probably to serve as Aliment to the incipient Embryo, till it is transplanted from the male to the female Parent, at length, both these Liquors are ejected with a considerable Force into the Uterus of the Female.

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² All the Parts which we have hitherto described are possessed by young Boys, without performing any Action, for the Space of sixteen Years, unless they are too early instructed that way by vicious Men; for in a Child the Vas Deferens is not pervious, nor can it be injected; and the seminal Vesicles are extremely small, being quite empty in a Fœtus: But after the Expiration of the forementioned Number of Years, the Beard, Voice, and other Signs of Virility, appear, and continue even to old Age. Thus old *Parre*, in the Reign of King *Charles* the Second, was convicted in Court for Adultery at the Age of 120 Years; nor are there other Instances wanting.

³ The Beard is the first Mark of Puberty; it being a constant Law of Nature, never to thrust out the Beard before the Semen begins to be formed: Nor will it then grow, if the Parts, destined to the Formation of the Semen, are destroyed by Castration: Nor will the Beard continue, when the Parts, destined to the Formation of the Semen, are thus injured, even in adult Age.

⁴ Hence in old Men, who are become impotent with Age, the Beard falls off, and the Head itself becomes bald.

⁵ The Voice of a Lad, before the Age of Puberty, differs not from that of a Girl; but when the Semen first begins to be formed, even before the Appearance of the Beard, the Voice breaks, and becomes more grave and masculine, and after this the Beard itself begins to appear.

⁶ If you object, that these Consequences do indeed follow, but they may perhaps result from other Causes than the Absorption or Return of the Semen, which we here propose; I shall endeavour to make answer by Experiments or Facts. There was an intrepid Soldier, who, aspiring after
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the Reward proposed by the General to him, who should first fix the Standard in the Enemies Fort, he climbed through the thick Battery of the Enemy, but, unfortunately, the Fire of a Cannon tore off both his Testicles; yet he recovered, and became, at length, effeminate, not in Mind, but in Body. The Strength of the several Muscles of the genital Parts still continued, and nothing was wanting towards his Virility but the Testicles, and yet his Voice soon altered, and Beard fell off. From hence I learnt, that those Changes which thus happen in those who are about the Age of Puberty, do not proceed from the entering the Age of fourteen Years, nor from any Change in the Fabric of the Body, but only because the Semen then begins to be formed; since, if the Testicles are absent, the Age makes no Alteration; but Effeminacy will continue even in the Age of Manhood, if, by any Accident, the Testicles are destroyed after Puberty.

⁷ In this Manner the *Arabians* have explained, why a few Drops of the Semen weaken more than the Loss of a large Quantity of Blood: There have been also some of the Moderns who have calculated how much the Body is weakened by a seminal Emission; but all this seems to arise from that Epilepsy or Convulsion which accompanies the Emission, and not from the Quantity of Semen lost; since the Strength returns in a little Time, even before the Semen itself can be restored again. Besides this, the Lensor of the Blood, as it moves so slowly, and the whole Apparatus by which Nature prepares the Semen, sufficiently demonstrate, that it differs as much, or more, from the Texture of animal Spirits, than Alcohol does from the White of an Egg; as will be evident to one who considers the Fabric of the cortical Part of the Brain with
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the Fabric of the Testicles, and the Tenuity of the animal Spirits with the Thickness or Consistence of the Semen.

⁸ There was a certain Professor who declared, that his Sal Volatile Oleosum was of the Nature of the Semen, and therefore was fit to excite Venery, a great Quantity thereof being vended for that Purpose; but this Effect followed from the increased Motion of the Blood, excited by the Sal Volatile, and not from its generating Semen: For these Salts are so remote from the Nature of Semen, that no two Bodies can be more foreign or distant to each other. This Error has been occasioned from observing, that the most salacious Animals, especially Goats, are the most strong-smelling; but this Scent of them proceeds from the oily Glands of the Scrotum and Perinæum, and not from the Semen.

⁹ These Muscles have been well figured and described by *Cowper*, but their Uses seem to be very different from those which are commonly ascribed: For since they arise on each Side the Urethra from the Os Ischium, and are inserted in that Part of the Urethra which is not yet joined by the Corpora Cavernosa Penis; it follows, that when these transverse Muscles contract, they draw the Urethra on each Side back towards the Os Ischium, so as to dilate the same, and form a Cavity into which the Semen is received, by the Contraction of the Muscles, compressing the seminal Vesicles and prostate Gland, discharging their Contents and mixing them with the Liquor of the mucous Glands of *Morgagni* and *Littre*.

¹⁰ The Accelerator is an antagonist Muscle to the former, arising from the back Part of the Perinæum, and investing the Bulb of the Urethra externally; extending afterwards to the Urethra itself, which it therefore compresses or contracts.

§. 658. *Origin of the Male Semen.* 95

¹¹ *Littre* adds this Muscle, which arises from the posterior Part where the Rectum is connected to the Neck of the Bladder, from whence it proceeds to the lower Part of the Urethra, of which it constricts a Part, which does not come within the Action of the Accelerator.

Having thus surveyed the Theory of these Parts, we may be able to understand the Diseases which frequently invade them. I have frequently had Diseases under my Cure, the Knowledge of which seemed to be very difficult before I was acquainted with the Structure and Action of the Organs. It was no difficult Matter indeed to send the Patient away with any Answer concerning the Cause of the Disease, the Discovery of which, nevertheless, appeared to me very difficult after Consideration. Thus, for Example, the Penis is very liable to Incurvation, either downward or to one Side, when it is erected; but upon considering the Fabric of these Parts prepared by *Ruyfch*, I could from thence, and from the external Appearances, determine, which Disorders of these Parts were incurable; namely, when the Incurvation of the Penis arises from a Weakness in one of the cavernous Bodies, also in the Disorders of *Cowper's* Glands, an Erosion of the seminal Vesicles, &c. The whole Nature of a Disease cannot be known, but by being acquainted with the Fabric of the Parts. Hence appears the Wisdom of *Hippocrates* in saying, that one ties, and another divides; and tho' both know not what they are about, yet Nature compleats the Design of each. Hitherto we have considered all that has been advanced with regard to Generation on the Part of the Male; nor do Philosophers know any more about this Matter; though *Cartesius* has endeavoured to explain the Formation of the Body by Ferments, affirming, that it might be pro-

96 *Origin of the Male Semen.* §. 659.

produced from a Drop of the Semen rarefying into a Froth, in the same Manner as a Point may be dilated into a Sphere; but the Creator was unwilling we should know these Mysteries, and has therefore prescribed Bounds to Infinity: He shews us a Circle, which is a well known Figure, but concerning which we cannot say what Proportion the Circumference bears to the Diameter. There are some, indeed, willing to extend their Enquiries from whence these seminal Animalcules are derived; but, for my own Part, I am content to stop short of these Subtleties.



Of the MENSTRUAL FLUX.

§. 659. **I**N Women the Os Sacrum is *broader*¹, and inclines more outward, than in Men; the Os Coccyx² is also in them turned more outward, and the Offa Innominata are broader, and *removed*³ to a greater Distance from each other above, as well as turned much more outward below; while, at the same Time, the lower Eminences of the Offa Pubis⁴ are carried more outwards or forwards: Hence, therefore, the Circumference round, and Space within, these Bones, together with the Capacity of the whole Pelvis, is *larger*⁵ in Women than in Men; and yet, in Women who are not with Child, there are not *many*⁶ Parts to fill this Cavity.

¹ The Os Sacrum is broad in Women, that it might the better sustain and defend the growing Fœtus; and it inclines backward, in order to increase the Capacity of the Pelvis.

² The Point of the Os Coccyx inclines forward to sustain the Fœtus, and at the same Time it is so articulated, that it may easily bend backward, in order to increase the Space for the Exclusion of the Fœtus.

³ When I examine the Pelvis of a male Skeleton in its lower Part, I perceive the Space betwixt the Bones to be there narrower than in the Pelvis of the Female, in which the Bones open wider; and as the Offa Pubis and Coccyx recede mutually to a greater Distance from each other, the whole Pelvis is therefore more capacious than in Men, supposing them to be of an equal Stature. This Difference in the Pelvis is so conspicuous to the Sight, that it serves for a distinguishing Mark to know the Skeleton of a Female from that of a Male.

⁴ Thus the Opening of the Pelvis is enlarged, through which the Fœtus is transmitted.

⁵ If you examine the Statue of a most beautiful Woman (as is that old one of *Venus*, which is preserved in Marble at *Rome*); and measure the Distance betwixt the lower Extremities of the Pelvis, you will find it to be one third Part more than the opposite Dimensions of the Thorax; but, on the contrary, if you measure the same Parts in the Statue of *Mercury*, *Hercules*, or any other well-shaped Man, you will find the Breadth of the Thorax to be one Third more than that of the Pelvis. And in this does the Make of the Female differ from that of the Male; namely, for providing a greater Space for the Reception of the Fœtus, which Space in the Male is much more

contracted by a closer Approximation of the Bones, inclining more inward.

⁶ The Parts here contained are the Bladder, which, when emptied, takes up very little Room; the Uterus, no larger than a small Pear; and the Intestinum Rectum, which in Women is very small: Whence it follows, that there is no Space throughout the whole Body, in which the contained Parts are less compressed than in the Pelvis of the Female; and from hence it is, that in Women every Excess or Redundancy of the Humours is determined downwards to these Parts. The Bladder indeed in Women is larger than in Men, but it is not so from the Birth, being gradually expanded, from its being situated in a more capacious Cavity; and hence it is that Women are capable of retaining their Urine longer than Men.

§. 660. Women have also the anterior Part of their Thorax much *flatter* ¹ than Men.

¹ That thus a greater Space might be made for receiving the Breasts, which ought to be distended with Milk; and also to facilitate the Gestation of the Fœtus: For the Center of Gravity in the Body changes in Women with Child, removing more forwards, whence they more easily fall that way, if the Thorax was to be removed; and we observe, that Women with Child tumble forward with the least Obstacle: Hence therefore the Thorax recedes somewhat backward, in some measure to remedy that Inconvenience.

§. 661. Besides this, the sanguiferous, lymphatic, adipose, and nervous Vessels, with the Membranes and Fibres, are much *laxer* ¹ in Women

§. 662. *Of the Menstrual Flux.* 99

Women than in Men; and hence all the Cavities, *Cells*², and *Vessels*³, are more easily filled⁴ in the Female, and the Humours more easily accumulated; and from hence we always observe the cellular and adipose Membrane to be very thick in Women, as the weaker Sex.

¹ If the dead Body of a Man and Woman lie together, covered from the Sight, one may easily distinguish one from the other, by making an Incision through the Skin of the Thigh, and comparing the Thickness of the adipose Membrane, and the Thinness of the Skin, in each Body.

² A lean Woman is fatter than a muscular Man; and therefore we easily distinguish the Muscles in a Man, which in a Woman are so deeply buried in Fat, that the whole Surface of the Body appears smooth and uniform.

³ The Arteries and Veins in a Woman are more large or capacious than in a Man, since in the former the Veins are easily extended into Varices. Hence it is, that a Woman is continually liable to a Plethora, upon the least Increase of Nourishment, if she is not freed from the Redundancy of Blood by the menstrual Discharge.

⁴ It is also remarkable, that a Woman, though of a delicate Habit, is capable of losing a large Quantity of Blood, even two or three Pounds, by Abortion, or the Lochia, without being thereby much weakened; whereas Half that Loss of Blood, occasioned either by Phlebotomy or a Wound, so much injures the Strength of a Man, that he either faints away, or dies suddenly.

§. 662. But in the mean Time it is observed, that Women perspire much less than Men, and they much sooner arrive at the full Extent of their *Growth*¹.

The human Body has its Bounds, beyond which it cannot grow in Length, and which it cannot much exceed in Bulk (§. 475.). These Limits are fixed or determined in Youth by the Bones, with respect to the Length of the Body; which can be no longer extended when the Bones become so hard or rigid, that they no longer suffer themselves to be extended by the Powers of the Heart and Arteries. But after the Body is thus arrived at its full Stature in Youth, beyond which it cannot exceed, the Abdomen is flat or even, the Ribs compressed, and the whole Body appears uniform by Nature, without the Assistance of Art; but from that Time the Body begins to enlarge in Thickness or Bulk, the Fat increasing, the Ribs are distended and thrust farther outward from their Contact with each other; the Abdomen also protuberates or projects forward, as yielding easily without Resistance; whence the Body becomes thicker, without growing taller. Thus the Thorax of a Woman before Gestation is more flat and contracted, but after the Birth the Thorax appears broader; because the continual Distention of the ascending Uterus protrudes the Ribs and Cartilages outward, and prevents them from returning to their former Dimensions, unless the Thorax be continually compressed by the Application of Rollers, as is customary with Ladies of Quality. But now a Woman arrives at this utmost Extent of her Growth, almost one third Part of her Years sooner than Man, and for the same Reason she is sooner fit for Procreation than the Male, who grows in Length or Stature, till he is past the Age of twenty-five; whereas a Woman arrives at her utmost Height by the Age of sixteen or eighteen Years, which she never exceeds, excepting in some uncommon Instances. From these

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Observations the Legislature in all Nations has allowed the Woman to be capable of giving her Consent at a younger Age; supposing that the Mind of the Female advances in Perfection proportionably as the Body grows swifter. But the Reason of this quicker Growth in the Female proceeds from the greater Laxity of their Vessels, which are more easily distended by the Blood impelled from the Heart. Now in a Woman of about sixteen Years old the Bones are indurated, and resist any farther Elongation; but the Vessels, in the mean Time, continue lax from their own Nature: In Consequence of which, they will be dilated, and give Rise to a Plethora, by an Accumulation of the alimentary Juices. But the Reason why the Bones do not continue to be so long extended in Women as in Men, proceeds from the greater Weakness of their Vessels, resulting from their greater Laxity; whence the Arteries are no longer able to extend the Bones, which are not harder in the Female than in the Male, only they oppose a greater Resistance to their more lax and weak Vessels.

§. 663. In the Cavity of the forementioned Pelvis (§. 659.) is seated a soft, pulpy Viscus, the *Uterus*¹, which is composed almost entirely of Vessels, easily *extendible*², and but little *elastic*³, and at Liberty on all Sides almost without any *Fastening*⁴, and suffering little or no *Pressure*⁵; it is, at the same Time, *defended*⁶ by an Expansion of the Membrane of the Peritonæum.

¹ The Uterus is commonly said to be a hollow Muscle, and to be furnished with fleshy Threads or Bundles of Fibres; but I must confess myself

ignorant where to find these muscular Portions. The Uterus of a Virgin of sixteen Years old is so small, when she has not her Menses, that it does not exceed an Inch and a Half in Length, and but a Finger and a Half in Breadth, in its widest Part, containing an exceeding small Cavity, its Fibres lying in a transverse Position. In this Age, the pulpy Substance of the Uterus appears altogether uniform, except at its Neck; nor are there any visible Arteries and Veins but in its external Surface; nor yet are there any Glands, but a particular kind of Substance, which *Galen* observing, thought the wonderful Sight demanded of him to sing a Hymn to *Jupiter*. It is a Contexture of Arteries and Veins, which do not appear visible in a Virgin; nor does even the Uterus of such, discharge Blood by Incision, but it appears perfectly white. But in Women with Child, the Uterus seems to be almost nothing but Blood; so that the Body which before hardly contained any visible Blood-Vessels, except in its Surface, is now found to have those Vessels so large, that they are capable of receiving one's Finger. But from this Bulk, after Delivery, the Uterus again returns, or contracts to its former Smallness; for I have seen the Uterus of a Woman, who had borne fourteen Children, contracted as small as the same Part in a Virgin.

² All this Difference betwixt the Uterus of a Woman with Child, and that of a Virgin, is owing to the distending Humours sent into its Vessels, without any Addition of Solids applied to the Vessels; and yet is the Uterus of a Woman with Child so much dilated, that, if she has Twins, it must contain twenty-four Pounds (§. 676.). This extraordinary Fabric being hardly extricable in the Uterus of a Woman, set *Malpighi* upon enquiring
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into the Uterus of a Cow. This Viscus then appears to be an Intertexture of Arteries and Veins, with intermediate Cells, whose Cavities in Pregnancy are filled with Mucus, but when the Uterus is empty, both the Vessels and Cryptæ are likewise all empty, as well in a Woman after she has borne Children, as in a Virgin out of the Time of her having Menses: Nor is there any Fat placed round the Uterus, except in those Females who have been castrated or spaded; and the same holds true likewise in the Scrotum of the Male: Nor are there any Glands in the Uterus, more than large Cryptæ distended with Liquor, into which the Inequalities of the human Placenta and Cotyledons of Brutes are rooted: This whole Viscus, from so small a Bulk, is distended to a considerable Magnitude; but how the Uterus, encompassed with such large Vessels, could be expanded from the Center to the Circumference by so moderate an Influx of the distending Humours, without being compressed by the surrounding Abdomen; and why the Ovum should be more easily distensible, than it is capable of being compressed by the Uterus; are Questions to which we are, as yet, not supplied with Answers. For all that which is in the Ovum, was derived from the Uterus: Nor can the Uterus be distended by Flatus; but its Enlargement seems to be derived from a conjunct Distension of all its Vessels.

³ The celebrated *Harvey*, whose Name must be always mentioned with Esteem, writes, that the Uterus contains in itself a Power of expelling the Fœtus; and that this Power is so considerable, that the Child has been found betwixt the Thighs of its dead Mother, by the Expulsion of the Uterus, after her Decease. Certain we are, that, after the Birth, the Uterus appears soft, like unto

wet Parchment, and that afterwards it shrinks up together, almost like the Bladder, without leaving any considerable Cavity; but then this is done very gradually, and without any Signs of Elasticity. After opening the Abdomen of a living Animal, I perforated the Bladder full of Urine by the Trocher, whereupon the Bladder contracted itself in Proportion, as the Urine was evacuated (§. 366.).

⁴ The Uterus is connected so freely, or at Liberty, that like an Animal in an Animal, according to the Observation of *Democritus*, it may be easily moved upward, downward, forward, backward, and to the right or left; so that both its Situation, as well as Figure, may be easily and frequently changed. This is an Observation of *Deventre*, namely, that the Os Uteri does not always correspond in a right Line to the Middle, or Access of the Vagina, but that it inclines forward, backward, or to either Side; but this is a necessary Disadvantage. Hence *Helmont* observes, that God has placed great Power in the Membranes of the Stomach to concoct the Food, and in the Uterus to transform itself.

⁵ We observe no Cause capable of compressing the Uterus, which is loosely sustained on all Sides by its Ligaments; for these are no more than loose Membranes.

⁶ For above the Uterus the Peritonæum is immediately expanded, so as to invest the same on all Sides; nor has it any other Membrane.

§. 664. The Uterus then being shaped like a Top, and composed of *Membranes*¹ and *Fibres*², receives Arteries from the *Spermatics*, *Hypogastrics*, internal *Iliacs*, and *Hæmorrhoidals*,

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morrhoidals, which being wonderfully wove together by reticular Plexuses, continually uniting by Anastomoses, running in and out, and contorted all round the Uterus, do at length disappear in its Substance, and seem to compose the greatest Part of the Body of the Uterus: To these, again, are added, Arteries from the *external Iliacs*³, which rising up in an Arch, pass through the Groins into the Pelvis, where they enter the Sides of the Uterus; in like manner, and from the same Origin, is the Uterus supplied with *Veins communicating*⁴ with each other, and destitute of *Valves*⁵, so that a Liquor may pass and repass from one into all the rest: Within its Cavity, the Uterus is perforated, not only by the Extremities of the Fallopian Tubes, but also by numerous small excretory *Ducts*⁶, transfusing a mild, aqueous, and mucous Humour, with which its internal Surface is defended and lubricated, so as to prevent its Sides or Cavity from concreting together.

¹ The Uterus is always covered with the Peritonæum, as with an external Coat, and is closed on all Sides, so as to be capable of receiving nothing, except through the Fallopian Tubes; but internally the Uterus is not invested by any Coat, lest its Distension should have been impeded; but instead of a Membrane, its internal Surface is lined with the Extremities of the exhaling or absorbing Vessels, and with *Lacunæ* full of Mucus in pregnant Women.

² The Fibres of the Uterus, when it is entire and distended with Blood, are not visible, for they then

then appear to be mere Vessels; but when the Uterus has been deprived of its Blood after Birth, so as to look pale, then those Fibres appear very numerous. Hence it follows, that the Uterus is composed almost entirely of Vessels which are often mistaken for Fibres. But you will, perhaps, reply, Has not *Ruyfch* discovered and described a Muscle in the Fundus of the Uterus? And was not an Uterus prepared by the Hand of that Anatomist, sold in public Auction, in the Fundus of which one might plainly perceive circular Membranes? Such Membranes, indeed, there are, but not Fibres. But what are they, then, if not Fibres? They are mere spongy *Lacunæ* full of Blood, as long as the Uterus is distended, and a Number of these contorted Vessels collected together, put on the Resemblance of muscular Fibres; whence *Malpighi* rightly observes, that he knows not what to make of the Uterus, not being able to find any Part of it muscular. Another Reason which induces me to believe these Fibres not muscular is, that they cannot be distended or elongated but by a greater Force than they can afterwards recover, by contracting to their former Length. I examined the Uterus of a Woman, almost ten Years after she had ceased bearing many Children, and I found it no larger than in a Virgin; and therefore it seems to follow, that the Fibres of the Uterus which suffer themselves to be dilated, and again contracted to so great a Degree, do not act by a muscular Power, but by some common Force of Elasticity.

³ In Men, the abdominal Muscles are perforated with an Opening on each Side, through which the spermatic Vessels descend to the Testicles; and, in like manner, in Women, there are two Apertures to be found under the Membrane of the Pe-

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Peritonæum. These are, by the Ancients, called the lower Ligaments of the Uterus; but *Drelin-court* derides the Opinion, by saying, that those Anatomists saw Woman in a Camera Obscura, who took these vascular Productions for Ligaments; since they cannot act as Ligaments to retain the Uterus, unless the Woman was to stand upon her Head or Hands. They are an infinite Number of Vessels coming out from the Thigh to the Uterus, as hath been represented by *Eustachius*, and afterwards by *Swammerdam*. Hence we may be able to understand the Nature of Herniæ in Women. A Hernia is said to be present, when the Peritonæum is thrust outward, into a kind of Sacculus, which, in Men, accompanies the spermatic Vessels; but, in Women (in which the simple Peritonæum incumbent upon those Vessels from the Thighs, are taken for Ligaments), the Intestines may prolapse, in like manner, by the Sides of those Vessels, so as to occasion either an inguinal Rupture, betwixt the Angle of the Femur and the Labia Pudendi, or else a Hernia Cruralis, in which the Intestines have been seen prolapsed into the Middle of the Femur. Hence *Mery* observes, that he saw the intestinal Fæces discharged from the Middle of the Thigh, by Rupture of the Intestine, which was prolapsed thither in the dilated Sacculus of the Peritonæum.

+ So that the crural Arteries have a mutual Communication, both with the Spermatics and with the internal Iliacs; and from thence the Uterus is plentifully supplied with Blood, in whatever Posture the Body of a Woman is placed: Even if five of the Sources were obstructed, and the sixth only remains open, that will be sufficient to supply all the Blood to the Uterus, which was before

fore sent by the other five Springs. For all the Vessels of the Uterus have a free Communication with each other, being destitute of Valves, so that the filling of one Artery constantly fills all the rest. *Eustachius* first taught, in his Tables, that there are no Valves to be found in the Vessels of the Uterus; and if Nature had not chose this Fabric, the Vessels might have been easily compressed by a Distension of the Uterus; whereas, now, it must be very difficult for an Obstruction to be formed. The same Contrivance is used by Nature in the Brain, where the vertebral and carotid Arteries communicate with each other (§. 233.). To the Uterus, therefore, the Blood descends by the Spermaties, it enters parallel by the Iliacs and Hæmorrhoidals, and ascends from the crural Arteries.

⁵ We may therefore pronounce the Uterus to be an Intertexture of Arteries and Veins, arising from several Quarters, and communicating with each other, and which have this peculiar Faculty, that both Arteries and Veins can contract from their increased Dimensions, and expel their Contents: For there is no Blood contained in the Uterus of a Virgin who has not her *Menses*; but in the ninth Month of Gestation the whole Uterus seems to consist entirely of sanguiferous Vessels distended with Blood; though from that Time they again contract themselves into a surprising small Compass, so that the largest sanguiferous Artery of the Uterus, undistended, is invisible, if compared with the sanguiferous Artery; and yet does this invisible Artery become so much enlarged in the gravid Uterus, as to be capable of admitting the End of a Goose Quill.

⁶ These Emissaries are never absent, but enlarge themselves, in Proportion as the Uterus is more dis-

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distended; being so small in Virgins, as to be scarce visible; but are so much enlarged when the Uterus is in the eighth Month of Pregnancy, that they have been seen to admit the End of one's Finger. They are filled with a mucous Humour; and it is into these Cavities that the Placenta is inserted.

§. 665. So soon therefore as a healthy *Virgin*¹ has attained to her full Growth, she begins to make *more*² good Juices than are required to nourish the Body; which Juices being no longer employed towards the Growth or Increase of the Body, will fill their Vessels *fuller than usual*³, more especially those of the Uterus and Breasts, as affording the least Resistance. These Vessels will be therefore more dilated than the rest; and from thence also the *lateral*⁴ small Vessels, which evacuate a Humour into the Cavity of the Uterus, will be much filled and extended; from whence will follow a Pain, Heat, and Sense of Heaviness, about the Loins, *Pubes, and Groins*⁵, which will be followed with a slight *Fever*⁶, until the small Vessels of the Uterus (§. 664.), *dilated*⁷ by these Causes, distil their Blood into the Cavity of the Uterus itself, whose Mouth being then lubricated and relaxed, gives the Blood an Opportunity to *escape*⁸; and thus the Fulness of the Vessels being diminished, those of the Uterus will be less pressed, their small lateral Branches will contract themselves more together, so as to retain all the larger or red Parts of the Blood, and transmit only the
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thick Serum, and at length only the thin Lymph, which was used to pass that way; and thus will the Parts continue, until the Quantity of Humours is again increased; whereupon they will be more easily deposited through the Vessels which have been now once dilated; whence the menstrual Discharge will cease, and return at particular *Intervals* ⁹ of Time. But the like Discharge may be also made by the Vessels (like those before described in the Uterus) seated in the *Vagina* ¹⁰ below the Os Uteri; and this we are taught from the *Menfes*, which are frequently discharged in some Women with Child, at certain Periods of Time, without any consequent Miscarriage; as also from their regular Flux, tho' not perfectly in a natural State, in some Women and Virgins, who have had their Uterus distended with a dark-colour'd Water for many Years, without ever opening its Mouth during all that Time.

¹ By this Name I understand a Woman who has arrived at the full Extent of her Growth, not then impregnated, nor lately lain in. The sixteenth Year is commonly fixed as the Limits of her Growth.

² From the very Day of the Birth of a Female, the Heart continually expands the Vessels, distends them with Humours, and by that means enlarges the whole Body, till at length the Bones become so solid, as to resist any farther Elongation by the Force of the Heart distending the Vessels; which last will be therefore more distended laterally. But suppose the Body to have grown an Ounce every

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Month; as the Growth now ceases, it follows, that this Ounce of superfluous alimantal Juices will be retained in the Vessels, and, by continual Addition, will excite a Plethora and all its Symptoms, unless that Quantity of Blood is by Nature discharged from some Part.

³ The Uterus being seated in the Pelvis, free from all Compressure, in an ample Space or Cavity, while all the other Parts of the Body are more compressed; therefore the Plethora or redundant Humours will flow to this less resisting Viscus: And at the same Time the Breasts, seated upon the pectoral Muscles, and covered only with a loose Fat and Skin, are likewise not subject to any Pressure; and hence it follows, that these Parts resisting less than the rest, therefore the Excess or Redundancy of the Humours will be determined towards the Uterus and Breasts, which have a reciprocal Consent or Communication with each other; for the Humours which, during the Time of Gestation, flowed to the Uterus, change their Course by the second or third Day after the Birth towards the Breasts, for the Formation of Milk. A little before the menstrual Flux, the Breasts of a Woman are turgid; but so soon as they flow, the Breasts collapse, and become flaccid.

⁴ These lateral Ducts are the Extremities of the Arteries, terminating with open Mouths, through which their contained Humours are deposited. These in the contracted Uterus contain only a serous or watery Humour; but when the Blood flows more copiously to this Part, they become larger, and discharge a greater Quantity of Moisture.

⁵ Because from these Parts arise some of the Blood-Vessels derived to the Uterus.

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⁶ Among a Thousand Women, there is hardly one to be found, who has not had something of a Fever before the Approach of the first menstrual Discharge; and even if she had no Fever, she must have perceived a Lassitude throughout her whole Body.

⁷ A Plethora dilates the Vessels, and rarefies the Humours; from whence their florid Colour will become more intense, the Pulse will become stronger, the Heat more intense, and at length there will be a true slight Fever. But the Arteries of the Uterus have this Peculiarity, that they can become exceeding large from a very small State, and can again contract from the largest to the least Dimensions. For the Arteries of the Uterus send off lateral Branches before they open into their corresponding Veins; so that the thinner Parts of the Blood will be forced through those lateral Branches, which terminate with open Mouths in the Cavity of the Uterus and Vagina, while the grosser Part of the Blood continues on through the corresponding Vein. If now the uterine Arteries are distended, their lateral Branches will be likewise dilated from the same Cause, till they are at length capable of receiving and transmitting the red Blood itself; by this means a slight Inflammation will be formed in the Uterus, and the same Causes continuing to urge the Blood forward into the lateral Vessels, will at length so expand them, as to change them entirely into sanguiferous Arteries: But we observed, that the Extremities of these lateral Branches terminate with open Mouths into the Cavity of the Uterus; and therefore the Blood will be discharged or distilled from these Orifices, so as to excite an Hæmorrhage from the Uterus, like that proceeding from a Dilatation of the Arteries of the Nose in a Child.

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⁸ But when the lateral arterial Ducts have thus sufficiently emptied themselves into the Cavity of the Uterus, they afterwards contract, and restore the Uterus to its former Dimensions and Figure. In this simple Manner is the whole Business of Menstruation performed by a Plethora only, without the Assistance of any imaginary Ferment. In this Manner then the Body is freed from its first Plethora by the Discharge of no more than a few Drops of Blood for the first Time, so as to leave a few Stains in the Linen. But within the Space of another Month, by what has been said before, the Plethora will be renewed, or even increased beyond what it was at first; and the uterine Arteries, which have already been once distended, will now again be more easily dilated; so that the returning Plethora will be attended with the same Symptoms, but milder, and the menstrual Discharge will be somewhat more copious. But when the Plethora returns no more, the menstrual Discharge will spontaneously cease, and with that the Fœcundity also of the Woman, namely, about the Age of 45 or 50.

⁹ There are some Women who have their Menses return in such exact Periods, that they can tell the Hour; and in others, the Time of their Appearance is uncertain, according to their Course of Life and particular Circumstances. Nor is it at all surprising, that the Menses should thus regularly return at stated Periods; for I have even known the Bodies of Men reduced by Art to be subject to a menstrual Plethora. For Example: A Man is sometimes ordered by his Physician to be bled for a Pain in the Head, of which he is perhaps relieved for the present; but after the Space of about a Month, the Plethora returns, and the Blood takes its Course by the carotid Arteries to the Head,

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where the Pain is again renewed, and by repeated bleeding, of which I cannot indeed much approve, the Pain is again removed. But after a Month or two more, the Plethora again returns; and thus will it approach at stated Intervals, unless the Disorder is radically extirpated. We have a certain Merchant here at *Leyden*, a Man of Probity, who discharges a larger Quantity of Blood every Month by the hæmorrhoidal Arteries, than is discharged from the Uterus of the most healthy Woman; namely, to the Quantity of a whole Pound, observing its stated Periods to an Hour: And thus, in a Manner, do some Men become effeminate. We have an Account of an *Irish* Gentleman in the *Philosophical Transactions*, who was every Month subject to Disorders, if he had not a Flux of Blood from the End of his little Finger; so that he had a periodical Return of the same Flux every Month, without leaving any apparent Signs of the Passages by which the Blood was discharged. When this Flux was endeavoured to be suppressed by Medicines, the Gentleman was flung into a violent Fit of Illness. It is therefore from hence apparent, that the human Body having several Times discharged its Blood by some certain Passage, it becomes customary for that Part to be, at particular Times, oppressed with Blood. The greater the Quantity of Blood which used to be discharged, so much the more Blood will distend or oppress the Part at the next Period, if the Person continues in Health, and the chylicative Viscera remain sound. *Lister* tells us, that the Butchers of *London* fatten their Calves very much by bleeding, and afterwards filling their Bodies with Milk; by which means a Plethora, not sanguine, is produced. The same Cause determines the Plethora to the Vessels of the Uterus, and of
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the Breasts; but if there is any other Part to which the Blood used to flow, then, indeed, it will no longer escape through the Uterus. A certain Maid has lived for these three Years past in the Hospital of *Amsterdam* (*Ann.* 1724.), who is every Month subject to a sweating of Blood from her Head, which is so extraordinary a Spectacle, that there are a Thousand Men living who have come thither for the Sight.

¹⁰ It cannot indeed be denied, but that the Blood may force its way through the lateral arterial Ducts, which open in the Vagina, as well as in the Uterus; as it may likewise by similar Ducts in the Nose, Ears, Mouth, Stomach, Intestines, &c.

§. 666. But since the mammary and epigastric Arteries wonderfully *communicate*¹ with each other by *Anastomoses*, and the Veins also do the same; it is evident, that the uterine Vessels being *evacuated*², those of the Breasts will be less distended, and therefore, when the Menfes approach, the Breasts will become turgid, and the Reverse.

¹ After *Riolan*, *Nucke*, by filling these Vessels with Injection, found, that they had a real Communication by *Anastomoses*, from whence, and from the Laxity of the Breasts, proceeds that remarkable Consent which we observe betwixt the Uterus and the Breasts: For whenever Nature has once opened a Way to herself, she always observes the same Course, so that the Blood is in a Manner, by Custom, every Month obliged to discharge itself by the genital Parts; and hence it is, that the Blood cannot be derived in an increased Quantity, either into the Vessels of the Uterus or

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Breasts, without flowing equally into both; and hence it is, that all Women have their Breasts swell four or five Days before their Menses, but more especially upon the Day in which their Menses appear. But after the Menses have been discharged, they again contract to their former Dimensions, till after the third Week their Distension returns. But the Breasts even in Women with Child, and soon after the Delivery, are distended by a Retention of the Menses. So soon as a Woman has conceived, the Uterus is closed, and the Blood, which is repelled from thence, enters the Breasts; but after the Birth, again the Uterus is emptied, whereupon the Breasts collapse, but in a short Interval the Uterus is again contracted, and then the Breasts are again distended with Milk.

² The Arteries of the Breasts do not come in a right Line from the adjacent Heart, but they ascend up to the Margin of the Thorax, and from thence they descend, in a retrograde Course, to the Breasts.

§. 667. From what has been said we may understand, why Women endowed with *hard*¹ strong Fibres, of a dry, lean, and muscular Habit, and also those who are daily used to hard *Labour*², have the menstrual Discharge less in Quantity, more slowly, and at longer Intervals, or even sometimes not at all? While, in the mean Time, those who are of a soft, lax, fat and *juicy*³ Habit, less muscular, and not addicted to Exercise, have this Discharge more copious, quicker, and returning at shorter Intervals? Also, why this Humour being retained,

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tained, makes itself so many and various *Outlets*⁴, by dilating other Vessels, from whence it discharges itself periodically? And why these Discharges appear at a certain Age, and in whom they increase most, appear first, or terminate last? And why again they sometimes cease too soon, or are suppressed before their Time?

¹ There are even whole Nations, whose Women are destitute of the Menfes; as in the Natives of *Scythia*, *Brazile*, and *Greenland*, &c. The *Scythian* Women are said to accompany their Husbands in War: They are reported to have very small Breasts, and hardly any menstrual Discharge, because they approach nearly to the Nature of the Male.

² For by Labour, the redundant Blood and Juices are dissipated.

³ I have known some beautiful Women of a very soft and delicate Habit, who have been hardly a Week free from the menstrual Flux; which is the Consequence of Idleness and Laxity of Habit; to which add the bad Custom which obtains among our *Dutch* Women of placing Fire-pots under their Petticoats and Feet: For, by this means, the Vessels below are relaxed, and the Blood solicited that Way; while, in the mean Time, the Body is idle and continually filled with the best Aliments and Drinks of Coffee, Tea, &c. For as, according to the Observation of *Lister*, repeated Bleeding increases the Plethora, so it is in Women with respect to this Discharge; till at length their Vessels are so much relaxed, that they retain very little Blood: But for this there is no Cure but Exercise, which if they refuse, about the

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fortieth Year of their Age, they perish with a Dropfy; or if, in the mean Time, they ever conceive, they generally miscarry.

⁴ There is no Part of the Body which has not, at one Time or another, afforded an Outlet to the Menfes. *Hippocrates* pronounces, that in those who have a Suppression of the Menfes, and a Distension of the Breasts, the Blood takes its Course to the Head, and occasions Madness. He observes likewise, that those who have a Spitting of Blood from a Retention of the Menfes, are cured by the Return of that Flux. I remember to have seen such an Hæmoptoe which became habitual, florid Blood being every Month spit up with a slight Cough, without any apparent Damage to the Patient's Health. I have sometimes known them discharged by a Vomiting of Blood, sometimes by a Diarrhæa or Sweat, and sometimes even from the internal Angles of the Eyes: But, in all these Instances, the Discharge is the same florid Blood, which will burst forth in any Part of the Body, when the Vessels of that Part acquire a like Disposition to those of the Uterus. For so soon as any Part of the Body becomes more dilatable than the Uterus, the Blood will flow into, and discharge itself from that Part, as it did before from the Uterus. *Hippocrates*, in his excellent Book, *De Morbis Mulierum*, tells us, that all Diseases may arise from the Menfes, and may be likewise cured by them. That if a Woman who has a Phrenzy, should be restored to her menstrual Flux, she will be certainly freed from the Disorder. Thus obstinate Head-achs are removed by a Return of the Menfes. Nor is this at all surprising, since these Disorders are occasioned by a Plethora; by removing which, as the Cause, the Disorder, as its Effect, ceases. When
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the Menfes appear at the fourteenth Year of Age in a Girl, they cease about the fortieth; and if they appear about the twenty-first Year, they continue longer in Proportion; even to the fiftieth Year, when they make their first Appearance about the twenty-fifth. The *Spanish* Women marry at eleven, twelve, thirteen, and fourteen, Years of Age; but then they cease to bear Children at the Age of thirty.—Add to this, that *Sanctorius* has observed Men to be subject to periodical Discharges, though not by a Flux of Blood: For Men every Month, by Degrees, become heavier by the Steelyard, as well as to the Sense; the Perspiration diminishes, the Body grows languid for two or three Days, the Appetite is weak, and the Man is obliged to remove the Plethora by Abstinence, or eating less, till at length a plentiful Sweat, or a copious Discharge of a thick Urine, terminates the Disease, until it returns again with the next Month.—Hitherto we have been treating of the redundant Blood generated in the Body of a healthy Woman, after she has arrived at her due Stature; but when such a Woman has conceived, then this menstrual Blood, being retained, is sent to nourish the Fœtus, which grows to the Weight of between six and ten Pounds, with the Placenta weighing two Pounds, to which add the Liquor of the Amnios, in the Formation of which is employed the superfluous Blood.



Of CONCEPTION.

CONCEPTION is a very old Word; and signifies that Action, by which the Female contributes, by the Assistance of the Male, towards the Propagation of the Species; namely, the Reception of that into the Womb, which is delivered from the Male.

§. 668. It appears from Anatomy, that two membranous *Canals* ¹ pass out from the two superior Perforations of the *Uterus* ², which gradually enlarge or *dilate* ³ themselves from their narrow Capacity at the Uterus, from whence they are *bent* ⁴ in a Sort of Semi-circle, with the Appearance of Cells and Inequalities, and at length terminate with a broad Opening, ornamented and surrounded with a kind of fleshy Edges or Fringes: These Tubes, which consist internally of a *glandular* ⁵ Membrane, with fleshy Sides, do almost in every Species of *Animals* ⁶, during the venereal Orgasm, become turgid, stiff, and full of Caruncles; and even in the dead Bodies of Women dissected, these Tubes have been seen, embracing the Ovaria, with their fleshy Edges or Fringes; and what is more, *Fætuses* ⁷ have been found of different Ages and Magnitudes, lodged in the cellular Recesses of the several Parts of these Tubes.

¹ They

¹ They pass out in such a Manner, that any Matter may be conveyed by them from the Uterus, towards their broad and fringed Extremities, with as much Ease, as they can transmit any Thing from those Extremities towards the Uterus, since they are not furnished with any Valves, but terminate and open with their broad, fringed, or membranous Extremities, into the Cavity of the Abdomen; yet do they not admit of any Thing from the Abdomen to the Uterus, or from the Uterus to the Abdomen, except a thin Vapour or Air.

² The Structure of which Part in a Woman is very different from that in Brutes: But in Women the Uterus has three Apertures; one by which it receives the male Semen, and two which open into the *Fallopian* Tubes.

³ These Tubes being very narrow at the Uterus, become larger towards their Extremities, from which Figure they have received the Denomination of Tubæ, or Trumpets, by their accurate Describer *Fallopius*; who, tho' he was not the Discoverer of the Tubes themselves, was yet the first who observed, that they terminated with a Cavity into that of the Uterus. From this Difference in their Largeness, it seems to follow, that they design to give a Passage rather from the Tube into the Uterus, than from the Uterus into the Tube.

⁴ The Reason of this Incurvation seems to be, that a greater Length of the Tube might lie in a small Compass, so as to afford a longer or more slow Passage. 2. To retard the Motion of any Thing passing either from the Uterus through the Tubes to their fringed Extremities, or from those Extremities towards the Uterus.

⁵ These Tubes are thick, rough, and villous, internally; beset with Cryptæ like Glands, discharging

charging a mucilaginous Liquor from the broader Basis towards the narrower Extremity of the Tube. These Tubes are placed within the Ligamenta Lata, which were by *Aretæus* compared to the Wings of a Bat; whence the Moderns have still retained their Denomination of *Alæ Vespertilionum*. But the Tubes themselves are loose, and sustained in a fluctuating Membrane, having nothing to hinder them from moving upward, downward, forward, backward, or to either Side; and so as to approach towards or recede farther from the Uterus with Ease.

⁶ The incomparable *Harvey* was happily supplied both with an acute Genius, and the free Gift of twelve Does, under the Munificence of King *Charles* the First; which Does he dissected at different Times after Conception, to carry on his excellent Work *De Generatione*. That excellent Anatomist has left us a History of the Generation of Animals, as much preferable to the Work of *Aristotle* upon the same Subject, as Gold is more valuable than Earth; notwithstanding *Alexander* supplied this his Master with so many Talents and Opportunities. The Females of all quadruped and walking Animals which breathe, are furnished with two uterine Tubes (for Birds have only one Tube), and in Cows the whole Uterus is manifestly divided into two Horns; but in Women the Horns are much narrower and smaller, being called Tubes. These uterine Tubes in Women, and Horns in Animals, are only affected at that Time in Brutes, who have particular Seasons for Copulation, when those Animals are by the Laws of Nature inclined to Lust: For the human Species only has no Time prefixed for Generation; whereas almost all other Animals have stated Seasons, in which both the Male and Female lust after each other, taking no Notice of each other the rest of the Year. The cele-

celebrated *Harvey* therefore readily perceived, that it would be most convenient for him to dissect Females, which at certain Times have an Inclination to Venery, in order to obtain a just Idea of Generation. For this End, therefore, he dissected Mares, Cows, Does, &c. as well in the Time when they refuse the Males, as when they lust after and admit them; and by Experiment he found, that there was no Difference to be observed in those that were impregnated and those that were not, except what might be seen in the Tubes and Ovaries: For the Tubes being opened in Females not impregnated, appeared smooth, lubricated, and spread with Mucus; whereas the Tubes of those which admitted the Male, appeared inflamed, and variegated with red Spots. Add to this, that the Tubes in the first, which had not admitted the Male, appeared collapsed downward, with their membranous or fringed Edges pendulous and flaccid; as they are always found in castrated Females. But after Venery, even in the Hen, the Tubes immediately appear stiff, with their membranous Edges expanded, and sometimes spread round the Ovarium.

7 There have been many Fœtuses found, lodged and nourished in these Tubes in Women, which has been the Occasion of their Death: Sometimes they have lain in the narrow Orifice of the Tube next the Uterus, sometimes in the curved Part of the Tube near its membranous Extremity, which is expanded like Fringes; and sometimes, again, they have been found upon the Surface of the Ovarium, embraced by the membranous Extremities of the Tube, expanded and connected to the Ovarium. But generally, in the human Species, the Fœtus is found in the Cavity of the Uterus; but in brute Females, which bring several at a Birth, they are generally found in the Horns or Tubes themselves.

§. 669. The two Ovaria are fastened to the *Uterus* ¹, at about the Distance of two Inches on each Side, by strong Ligaments, invested and *secured* ² by other Membranes arising from the Peritonæum; these Ovaria are *large* ³ and rough surfaced, of a *spheroidical* ⁴ Figure, *inclosed* ⁵ in a firm Membrane, and supplied by the spermatic, hypogastric, and other Arteries, which before their Entrance communicate so together as to form one reticular Plexus, as if it were one Vessel; whereas there are an infinite Number in Proportion to the Size of this Body: And the same is also true, with respect to the Veins and numerous lymphatic Vessels; all which Vessels with Nerves, are so intricately wove together, as to compose the Fabric of the Ovarium in such a Manner, that it can *scarcely* ⁶ be described. But in the Surface of the Ovaria, under their including Membrane, we find little *Spherules* ⁷ or Eggs, growing by pretty thick *Foot-stalks* ⁸ to the Surface of the Ovarium, and composed of *two* ⁹ concentric Membranes, very strictly connected to each other, and filled with a pellucid, lymphatic Humour, hardening with Heat or Fire. These Ovaria are always to be found present in the Body of a healthy Woman; but in Girls, before the Age of Puberty, they are very *small* ¹⁰, become gradually larger, and are largest at the Time of their Impregnation; but in *old Women* ¹¹ they again shrink up or diminish. The forementioned Spherules adhere by their Foot-stalks

stalks to the Extremities of the before described minute Vessels, and seldom appear thus but after venereal *Congress* ¹² with the Male; after which gradually enlarging, and by Degrees becoming more pellucid, their Membranes growing thicker, elevate and *extend* ¹³ the common Integument of the Ovarium, so as to hang pendulous like a small Grape by its Foot-stalk; and being at length quite separated, a small Cicatrix is left in the Substance and Membrane of the broken Ovary. Lastly, *Fætuses* ¹⁴ have been found even included in these Eggs, while they were yet adhering to the Ovarium.

¹ The Ovaria are fixed within the same Membrane that invests the *Fallopian* Tubes, being continuous with the Tunic that is expanded over the Uterus; yet do they not touch either the Uterus or the Tubes in any Part, being seated in a Plane at some Distance from each other.

² They are firmly secured in such a Manner, that they cannot fall out of their including Membrane; yet are they moveable, so as to lie either above, below, or at a small Distance from the Tube.

³ In Magnitude they are not more than Half so big as the male Testicles. They formerly likewise were denominated Testicles, though they are the Ovaries common to all female Animals; first called Ovaria by *Steno* in his View of the Muscles, *Ann.* 1667. These are sometimes taken out of Cows and Hogs destined to be fattened, the Wound by which they were extracted being afterwards cured by the Gelder: But the Females thus castrated are never after inclined to Venery, nor do they ever conceive. There was a Man who followed
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this Business in *Germany*, who finding that his Daughter violated her Chastity, was so much angered, that he made an Incision in her Side, and castrated the Girl, who from that Time was not touched with any Inclinations to Venery.

^{4, 5} They are of a spherical but somewhat depressed Figure. In Virgins they are small, but at the Time of Venery they always appear rough, large, and full of Blood.

⁶ As no one has hitherto explained the Fabric of the male Testicle, so likewise the Structure of the Testicle or Ovarium of the Female also continues still in Obscurity. The male Testicle cannot be unravelled; and *Bellini* was in an Error in believing the Length of the feminal Tube to be, with regard to its Weight, as a small Thread rolled up of a Heap, and weighed: From whence he conjectured the feminal Vessels to be 300 *Florentine* Ells in Length; whereas there are an Hundred feminal Vessels, all of them exceeding short, as we are now assured from the Preparations of *Ruysch*. But it is much more difficult to discover any Thing of the Fabric of the female Ovarium, since neither *Ruysch* with his ceracious, nor *Nucke* with his mercurial Injection, though made with the greatest Artifice, could ever detect any Thing of its Structure. The Arteries seem, as it were, to terminate on all Sides; and the Veins seem to arise first from the upper Part of the Ovarium; and besides these we find no other Vessels, which being interwove together, must therefore compose the Substance of the Ovarium: But what others have licentiously wrote concerning the Fabric of this Part, are the mere Fruits of Imagination. These Spheres or Ova are found in all female Animals, whether human or brutal, extinguished in Health and in the Vigour of their Age.

⁷ *Malpighi* is the only Person who has given us a just Description of them; namely, that the Ova consist of three Parts; to wit, a glandular Calyx or Cup, and two Membranes; and that after Impregnation they grow gradually larger.

⁸ The Calyx, which is to this Body like a Cup to its Acorn, does, after a certain Time, separate the one from the other. When the Ovary of a healthy Cow is taken out of the Body to be examined, if it be macerated a considerable Time in warm Water, the lymphatic Vessels will become conspicuous. In the next Place, let the external Membrane be removed, which conceals its Fabric, and the interior Face of the Ovary will then appear rough, beset with small Tubercles on all Sides, of a yellowish Colour; which are by *Malpighi* called the Calices, being much like the Yolks of small Eggs found in the Ovaries of Pullets. The Fabric of these Calices is quite singular, resembling a fleshy or glandular Substance, and the Figure of it concave, whence its Name. From the Concavities of the Corpora Lutea arise Vesicles full of a pellucid Lymph or Water, seated in its little Cup, by which it is altogether invested, and does not approach to the Surface of the Ovarium, while the Ovum continues immature. But after Venery the Cavity of the Calyx or Case including the Ovum expands itself, and its including Vesicle becomes turgid, so as at length to project almost entirely beyond the Substance of the Ovary itself, the Calyx suspending only its Basis. These Vesicles have been denominated Ova by the Learned: But an Ovum is not a pellucid Vesicle filled with a few Drops of Liquor, as it is generally described; but it is a Sort of fleshy Cup, containing the Spherule or Ovum like a Filbeard in its Case, the Cup of the Ovum being larger in Proportion as its included Sphe-

Spherule is less, and less in Proportion as the Ovum is enlarged, or has continued a longer Time since it was impregnated. This Cup, together with its Spherule, being conveyed into the Uterus, does there take Root and adhere, while the Ovum itself expands into the Membranes termed Chorion and Amnios, filled with Water; so that the Foetus is not seated in the Cup, but in the expanded Spherule, which contains a Liquor thinner indeed than the White of an Egg, but yet hardening like that with the Heat of boiling Water.

⁹ Which Membranes may be separated from each other, the external forming the Chorion, and the internal the Amnios: But the Cup itself constitutes the Placenta, which is a Production of the Ovum, and not of the Uterus, notwithstanding it adheres to this last. Lastly, The male Semen or Animalcule being lodged in the Middle of this Ovum, is included by its Membranes, and forms the Foetus.

¹⁰ These are exceeding small in young Girls, yet are they large enough to be demonstrated.

¹¹ The Ovaries, both in human and brutal Females, shrink up and perish in old Age; whereas the Testicles of the Male always continue. For Nature has appointed the Time, beyond which no Female is capable of conceiving; whereas the Males have no such Time limited, but they continue capable of Generation, though ever so old, in Proportion to their Strength or Habit. We observed before (§. 658.), that old *Parre* of *England* was found guilty of Adultery at the Age of 120, and that he had got Children not long before.

¹² Whether this be in ludicrous Dreams, or by Venery exercised agreeable to the Laws of Nature; for both Men and Women, as well as brute Animals, are capable of being affected in their Dreams,

Dreams, with what they can perceive when they are awake, that is, the Male may discharge his Semen and the Female her Ova from the Ovaria, as in a strong and legitimate Venery.

¹³ This appears from the extraordinary Observations of *De Graaf*, who dissected an Hundred Rabbits, and Forty Sheep, with this View. The female Rabbit, admitted to the Buck, almost infallibly conceives, and brings four or five young Ones from one Conception. So many Foetuses as are conceived, so many Vesicles appear prominent in the Ovarium after Coition, as is evident, from the Agreement of repeated Experiments. These Spherules enlarging, project beyond the Surface of the Ovarium, elevate and dilate its including Membrane, till, at length, the Spherule makes its way through an Opening of the same Membrane, and hangs out of the Ovarium, still adhering strictly to its Calix; but then, by the Action of the *Fallopian* Tube, the Ovum is, in a Manner, swallowed thereby, and conveyed into the Uterus, where it becomes an impregnated Ovum, if it was not so before, leaving a Cicatrix in the Substance of the Ovarium, from whence it came; which gradually disappears; as the Membrane of the Ovary closes. But this is worthy to be admired; namely, that this Spherule should be capable of separating itself from the Ovary, when it is entirely covered with a Membrane, as strong and dense as the Cuticle of the Face. Here we might ask, How it makes this Escape? But we are well acquainted with other Laws of Nature, no less surprising, for which we cannot account, by all our Ingenuity. Hypotheses would in vain account for the Business of Conception, Nutrition, and Parturition, without making any real Advancement; but Experience discovers the Laws which are repugnant to all

Hypotheses. Men are not capable of understanding Beings and their Natures, like their Creator; nor were they present at the first Formation of Things, and yet are they proud enough to judge, censure, and determine in these Matters. If you open a Pullet, and inspect the Uterus, you will perceive the Ovarium or Bunch of Eggs connected to the Loins, and filled with yellow Spherules, perhaps, to the Number of about thirty: In the smallest of these, the Calyx only appears without any Signs of the Ovum, which is contained in the Center of the former: But the larger of these have the Yolk, or something like it, from the Center of which proceeds the Albumen, a Membrane being expanded over the Surface of them both. There are often thirty of these Eggs in a Bunch. But all the Eggs, as well those which are the most remote, as them which are the most advanced towards Exclusion, are invested in one common Membrane, which is extended in such a Manner by the growing Ovum, that it, at length, opens a Passage for its Exclusion. If you ask how this is brought about, no Answer can be given, more than that it is a Law of Nature. These Yolks come first from the Center into the Uterus, and afterwards, by Degrees, all of them are excluded out of the Ovary. In that Egg which is next to the Tube, larger than the rest, there first arises from the Middle of the Yolk, a Body covered with two Membranes, namely, the Albumen, which enlarges as the Egg advances further, till it is at length completely formed, both of the Albumen and Yolk; round which, in the Fallopian Tube, is spread a chalky or stony Substance forming the Shell. There is therefore no Room to doubt, but that by an inviolable Law of Nature, in all oviparous Animals,

mals, all the Ova of the same Ovary are bound over by one strong Membrane, and yet only one at a Time is excluded through this Membrane, dilated, without Laceration, into the *Fallopian* Tube; and this, whether the Hen be admitted to the Cock, or not.

¹⁴ Of this Nature there are several Instances, in the *Philosophical Transactions*, the *French Memoirs*, and the *German Ephemerides*. Women have conceived, and gone their full Time, when the Throws or Pains, usual in Delivery, approaching, the Mother has been retained a long Time in these Agonies to no Purpose; while the Woman, or even the Man-Midwife, have not been able to discover any Thing in the Womb; till, at length, the unhappy Mother has perished. Upon opening the Abdomen, a perfect Fœtus, of nine Months old, has been found either in the Ovary, in the *Fallopian* Tube, or in the Cavity of the Abdomen; yet in such a Manner, that the Placenta still adhered to the Ovarium, though, at the same Time, the Uterus itself has appeared entire, clean, and empty; whereas, according to the Course of Nature, the Ovum ought to have been conveyed into the Uterus, and to have continued there, till it was brought to Maturity.

§. 670. From all these Observations, it seems sufficiently evident, that these vesicular Spherules are *Ova*^r, Eggs, formed, as to their Fabric, from the small Vessels; and supplied, as to their Humours, by those of the Part itself, wonderfully prepared and elaborated: And that therefore this whole, and so surprising Fabric, was designed by Nature entirely for this great Purpose of propagating our Species.

The Truth of this, I think, may be made evident even to Demonstration. For Example, let us take one of the largest oviparous Fowls, as a Goose or Swan, full grown, and in Health: In this Fowl, agreeable to the Observation of *Aristotle*, followed by *Aquapendens*, *Harvey*, *Malpighi*, and *Bellini*, we find, under the Lungs, an oblong Body, of an indeterminate Figure, commonly called the Egg-Bag, round which grows numerous Tubercles, all of them included in one common Membrane. These Tubercles are Ova, of which some are large and more mature, and others less; but, as yet, the Yolk appears very large, while the Albumen is hardly perceptible. This Body, then, is an Ovum made up by the Corpus Luteum, which encompasses the Yolk like a Shell, while from a Sacculus placed in the Center, gradually expanding itself towards the whole Circumference, the Albumen is, at length, formed. The Ovum, thus formed, continues adhering to the Infundibulum or Calyx for some Time, projecting out of the Ovarium, and growing very fast, the Albumen increasing apace, but the Yolk slowly; so that, in a short Time, the whole Yolk is covered over with the Albumen. The Ovum is now complete, but, as yet, soft: For if a Hen be opened, at this Time, you find the two external Membranes; and in the Center, towards the obtuse End, is the Yolk, about which is spread the Albumen. In the Center of the Yolk is lodged the Sacculus of Colliquamentum, very small, which goes into the Chorion and Amnios; but the Yolk enters the Placenta, from whence the umbilical Vessels arise: Lastly, in the Center of the Sacculus of the Colliquamentum is seated the young Chick in a Point. The Advancement of all these have been gradually observed, Hour after Hour, by *Malpighi*. The Eggs
of

of Women, indeed, have no Shells, nor is the Shell properly Part of the Egg, only it serves as a Defence to preserve it from Injuries, either from the Weight of itself, or of the Mother during Incubation. Nor had the Egg any Shell while it lay in the Ovarium; but that is acquired in the Uropygium, where there is a Bag containing cretaceous Matter, which is spread round every Side of the Ovum there deposited, and is quite soft six Hours before the Egg is excluded, but by the Air, it continually hardens into a stony Crust. But neither is the Albumen an essential Part of the Egg, being only the first Aliment of the Chick, spread round the incipient Animal, that it might not be destitute of Nourishment during the twenty Days of its Incubation. The Whole, therefore, which properly constitutes the Egg, is made up of the Yolk and Sacculus of Colliquamentum. Nor is the Reason obscure, why human Ova are destitute of the Shell and Albumen: For the former is unnecessary, because the Ovum is deposited in a secure Receptacle, the soft Uterus; and the Albumen is unnecessary, because it is nourished from the Mother during the whole Time of Gestation: But it is furnished both with the Yolk, namely, the Placenta; and with the Sacculus of Colliquamentum, namely, the Amnios. The only Difference, therefore, betwixt the Eggs of oviparous and viviparous Animals is, that, in the latter, the Shell and Albumen are wanting, as being unnecessary; whereas, in other Respects, they are perfectly the same. I am therefore surpris'd at some Gentlemen of Note, who deny that there is any Resemblance betwixt the Ova of viviparous and oviparous Animals.

§. 671. From thence also we learn, that the *Fallopian* Tubes, growing stiff in the venereal Act, embrace the Ovaries with their muscular Fringes or Edges as with Fingers; and that, while the Ovary is thus pressed, the Tube dilates its Opening during its Embraces, and the mature Ovum then gradually separating, is urged into its Cavity; from whence, by the Motion of its muscular Sides, it is gradually propelled, till at length it is, by the same Means, conveyed into the Cavity of the *Uterus*¹, where it is either nourished, if the Male Semen be present; or else discharged, if received into that Part without being impregnated.

¹ It is by many doubted, whether the Ovum is thus always conveyed to the Uterus by the *Fallopian* Tube, since the Tube is not continuous with, but removed at some Distance from, the Ovary; nor does the Tube seem capable of embracing the Ovary, without being under the Influence of the Mind to direct it: But this not being probable, seems to denote the Whole to be a Supposition. But no Philosopher ought to suppose any Appearance impossible, but what is repugnant to the Means of Demonstration; for we acquire our Ideas concerning the Nature of Man's Origin, not so much by our Senses immediately, as by a diligent Attention to the several Appearances, assisted by just Reasoning. The Egg-Bag of a Hen is fastened to the Loins, from whence the Uropigium and Infundibulum, which ought to receive the Egg, are placed at a considerable Distance,

stance, and hang pendulous in the Cavity of the Abdomen. Yet we find, that, by the venereal Appetite excited, the Infundibulum or Tube of the Hen is erected, embraces the Ovarium, and takes the Ovum into itself, where it is retained and nourished for some Days, and then conveyed to its natural Exclusion. From hence then we know, for certain, that the flaccid Tube, though at some Distance from the Ovarium, is naturally capable of embracing and receiving the Ovum into its Cavity, without letting it fall into the Cavity of the Abdomen, except in some extraordinary Cases. Nothing is therefore more certain, than that the Ovum is thus received by, and transmitted through, the *Fallopian* Tube, from the Ovary; even though it must be confessed, that when these Tubes are flaccid and remote, they do not seem very capable of this Action.

§. 672. For if we attend to those Appearances which manifestly happen to all oviparous Animals, as well as to those which are demonstrated to the *Eye* itself, in viviparous Animals, at different Times, after Coition; and, lastly, if we consider what happens to Women, whether naturally, or preternaturally, in a State of Gravitation, Lying-in, and when freed by the Birth, or Delivery, it will be from thence *evident*², that this Method, or Course of Nature, in the Business of Generation, is neither impossible nor *inconsistent*³; but, on the contrary, that it holds universally true: The same is also confirmed by false Conceptions, Abortions, and Fœtuses found in the Cavity of the *Abdomen*⁴, &c.

¹ *Harvey* has observed the *Fallopian* Tubes rigid, and applied round the Ovaria; and he saw a human Uterus, in which the Fringes of the Tubes were connected to the Ovary: Whence it follows, that it is not repugnant to Nature for the Ovum to be received by, and transmitted through, the *Fallopian* Tubes into the Cavity of the Uterus. Again, every *Saturday*, in the *Pork-Market*, there are, perhaps, a Hundred young Sows castrated, that they may fatten the sooner; the Operation being performed in the following Manner: The Gelder makes an Incision in the Abdomen, a little above the Spine of the Os Ilium, and, inserting his Finger, takes hold of the Tube, together with the Ovarium, which being drawn out through the Wound, the latter is cut off, the Tube returned, and the Wound sewed up: But, after this, that Sow never conceives, even though the Uterus was not at all touched. You will perhaps object, that the Animal becomes sterile because the Ovaria prepare a Semen; but if that is the Office of the Ovary, agreeable to the Antients, How comes that Semen to be rather conveyed into the Uterus, than into the Cavity of the Abdomen? All that can be said is, that the Creator would have it thus; nor do I conceive the Matter to be any other Way possible, since the Mouth of the Tube so manifestly opens into the Cavity of the Abdomen; and yet the Ovum never drops into that Cavity, as far as we can learn from Observations. Upon the Whole, then, it is sufficiently manifest, that the Use of the female Testicles, as they are called by the Ancients, is, to form Eggs, which, when arrived to Maturity, are, by the venereal Orgasm, conveyed into the *Fallopian* Tube, which embraces the Ovarium on all Sides with its Fringes, as with so many Fingers, and, receiving the Ovum,

it

it is, by the *Fallopian* Tube, conveyed into the Cavity of the Uterus. If now the Ovum descending into the Uterus there meets with the Semen Masculinum, the Os Tincæ being contracted, the Ovum is retained; but if the Semen is not there, the Ovum slips insensibly out of the Body.

² Who would imagine, if they had not seen, that the Skin of the Abdomen, in a Woman with Child, is so vastly distended? But this alone is sufficient to demonstrate how extensible Membranes are.

³ If a Cow is killed six Months after calving, if she has borne but one Calf, you will find but one Cicatrix in the Ovarium, two Cicatrices if she had two Calves, and twelve if, by some extraordinary Accident, she could have brought forth twelve Fœtuses. Again, let a Cow be killed the third Day after Coition, and a protuberant Spherule will appear in the Surface of the Ovarium. At that Time, therefore, when the Female inclines to Lust, the latent Ovum grows, swells, and thrusts itself outward, so as to dilate the Membrane which includes the Ovarium. The inferior Part of this Spherule is always thicker than the rest, as being the Part which afterwards forms the Placenta; whereas the other Part of the Ovum, which is thinner, forms the Chorion and Amnios. But then how do these Ova or Fœtuses, which leave an Opening in the Membrane of the Ovarium, make their way into the Uterus? There is certainly no other Way for them than through the *Fallopian* Tubes.

⁴ The same Rule is observed in the human Species; as we learn from an Instance mentioned in the *Memoirs* of the *Royal Academy* at *Paris*; where a Woman dying in Labour was opened, whereupon a large Fœtus was found in the Cavity of the Abdomen; and the *Fallopian* Tube was observed growing to the Ovarium.

§. 673. The Male Semen, therefore, replete with living Animalcules, excited or enlivened considerably by intense Heat, and perhaps a large Flow of animal *Spirits*¹, being thrown, with a considerable Force, through the Mouth of the Womb, now more relaxed or open; and the Valves of its Neck, as well as those of the Uterus itself, being now more loose, turgid, and, in a Manner, slightly *inflamed*², is likewise more plentifully supplied with its moistening *Lymph*³ and animal Spirits; while the nervous Papillæ in the wrinkled Furrows of the Vagina, being tickled by Attrition; the Uterus is, by that means, soon after thrown into a convulsive *Contraction*⁴; in which, being heated and agitated, the Ovum, *conveyed*⁵ into it, receives an incredible small living Animalcule, through the then dilated *Pores*⁶ of the glandular Membrane of the Ovum; which is thereupon retained in the Womb, enlarged, and grows or adheres to some Part by its Placenta, while the rest and less vivid Animalcules are suffocated; and thus is Conception performed.

¹ There have been some of the Ancients who have placed the Seat of Lust in the upper Orifice of the Stomach, and about the Loins and Mesentery; and their Reason for this was, because, in Men exhausted by Venery, there is always a Relaxation and Disorder of the Stomach and Loins.

² In this State there is always an Inflammation or increased Heat of the Parts both in the Male and Female, and that the most intense which a Person

Person is able to bear from the Violence and Agitation of the arterial Blood; and if this Inflammation which accompanies the venereal Orgasm in the Male and Female be too long continued, it may, at length, terminate in a Gangrene. But, at the same Time, the Semen Masculinum and the Ovum of the Female are also very much heated and violently agitated, and, in the mean Time, the Male Semen passes into the Uterus, in which consists all that the Male contributes towards Generation.

³ In all Animals which have an Inclination to Venery, there is a kind of mucous frothy Matter distils from the Parts; and, by this Sign, Cows are known to be fit for the Bull.—But this our Theory is opposed by the Authority of the celebrated *Harvey*, which, it must be confessed, is almost sufficient to put us into a Doubt. This Gentleman, who deserves the highest Credit, and the first Place among those who discover Nature by Experiment, could never find any thick Semen in the Uterus soon after Coition, notwithstanding he dissected a vast Number of Mares, Does, Deer, &c. in which Animals the Male seems to supply so large a Quantity of Semen, that it is not probable it could entirely escape the Sight. But this is opposed by the Authority and Experience of *Ruyfch*, who, in Company with many Physicians that were Eye-witnesses, testifies, that he always found the contrary in two unfortunate Cases of Women killed just after Coition. In the first Case, an Officer having, with great Importunities, obtained Admission from a beautiful Harlot, being soon after Coition thrown into a great Rage, divided the carotid Arteries by cutting the unfortunate Creature's Throat. In the other Case, a Man, finding his Wife in the Act of Adultery, immediately killed her. In these Cases,

Cases, *Ruysch* being sent, by Order of the Magistrates, to examine the Bodies, found, in the Cavity of the Uterus, a Quantity of true Semen, which being put together with the Parts into Alcohol Vini, immediately hardened, and was preserved, together with the Uterus; so that, at this Day, the same may be seen in the Treasure of this Anatomist, which was bought by the Empress of *Russia*. On the other Hand, we believe, that the excellent *Harvey* could neither be deceived himself, nor would deceive others, in a Matter in which he was so well skilled, and so well supplied by numerous Experiments, made on a great Number of vast Animals. We must therefore endeavour to reconcile these contradictory Experiments of *Harvey* and *Ruysch*. The former, it must be observed, made his Experiments upon cloven-footed Animals, in which the Uterus is divided into two Branches or Arms; whence the Semen might be easily dispersed and lost to the Sight, by spreading over so large a Compass, whence very little might be left in the Uterus: But *Ruysch*, on the contrary, made his Experiments upon Women, in which the Uterus has but one Cavity. The Opinion of *Ruysch* is also countenanced by the common Experience of Women, who know themselves to have conceived from this single Sign; namely, if the Semen is not discharged again out of the Uterus after Venery. Add to this, that Grooms make a like Observation; who, after a Mare has been leaped by a fine Horse, which is often procured with great Difficulty; they look upon it as an infallible Means to make her conceive, if they pour a Pail of cold Water upon the genital Parts of the Mare; by which means the Uterus contracts, and prevents the Semen from escaping, except a little which comes away a considerable Time after, when it has performed its Office.

After

⁴ After Conception the Uterus is closed, or contracted; and the Moment after brute Animals have conceived, we observe their Loins shrink, followed with a Contraction of the Uterus.

⁵ For at that Moment of Time is the best Opportunity of Conception, in which the Heat of the Parts in both Sexes is the greatest, being much more intense than that of a common Fever: For, by this means, the most active Parts of the Semen are rendered still more active; and then, if, at the same Instant, the Semen of the Male meets with the Ovum of the Female, Conception then follows, the prolific Power of the male Semen penetrating into the Sacculus of the Colliquamentum.

⁶ The female Ovum arises from the ultimate Extremities of the curling Arteries distributed to the Ovaria, as we are taught by *Swammerdam* and *Ruyfch*. The Calyx or Corpus Luteum belonging to each Ovum, is the Rudiments of the Placenta in the human Species; but in brute Animals it forms the Cotyledon. By this Calyx, and not by the Membranes of the Ovum, it communicates with the Ovarium; the Calyx itself being the Rudiments or Beginning of the Ovum, and the Extremity of the conglomerated Vessels: Yet is the Ovum separated from the Ovarium without any Laceration of the Vessels; so, however, that the Part of the Ovum by which it is connected to the Ovary, still continues weakest. When, therefore, the Ovum is heated, tumefied, and distended, in the venereal Orgasm; then that Part of the male Semen which fecundates the Ovum, enters through the ruptured Vessels, by which the Ovum was formerly nourished, and adheres to the Ovary: And this whether you suppose the fecundating Part of the Semen to be volatile, like a Wind or Spirit, according to *Vaillant*; or whether you suppose

pose an Animalcule to be admitted, according to *Lewenhoeck*, who makes the Animalcule ten Millions of Times less than a Grain of Sand: For in both these Systems the prolific Semen must enter the Ovum the same Way, and no other. But since the male Semen is universally allowed to communicate with the Ovum, and since the most active Part of that Semen appears by the Microscope to be an Heap of Animalcules; it follows, that these are the most likely, and probably the real Cause of Fœcundation.

§. 674. Conception may therefore take Place in all that Space wherein this prolific Semen can penetrate the Ovum; and therefore it may be by the Semen poured upon the Ovum by the *Fallopian* Tube embracing the *Ovary*¹, or by the Semen meeting with the Ovum in some of the Recesses of the same Tube, or in the Cavity of the Uterus itself; and though either of these may produce the *same*² Effect, yet it is not improbable but that the most perfect Conception happens, when both the Semen and the Ovum are conveyed together at the same Time, and meet in the Cavity of the Uterus³.

¹ Fœtuses have been found in the human Species lodged in the Ovum, still adhering to the Ovarium; in which Cases the male Semen must have been conveyed to the Ovarium, either from the Cavity of the Uterus by the *Fallopian* Tube embracing the Ovarium, which is the most common and received Opinion; or else, according to the *Harveian* Doctrine, the spirituous Parts of the male

male Semen must insinuate into the Veins of the Uterus, and enter into the Mass of Blood, and must, by the Course of the Circulation, be conveyed to the Ovum through the Arteries. But I must confess, this Method is not agreeable to the Nature of Things: For if the prolific Power of the Semen must pass to the Ovum through the Heart and Lungs of the Mother, it must be very easy for it to mistake its Course, and pass to another Part at a considerable Distance from the Ovary, unless we can find out some other Assistances.

² That is, in any Part where the prolific Semen can be applied to the Ovum.

³ It is a Question controverted, Whether the foecundated Semen meets with the Ovum in the Uterus? Thus thinks *De Graaf*, who has removed many Difficulties, and cleared up many Doubts, in these Matters: He made his Experiments upon House-Rabbits, which are a kind of Animal so prolific, that they conceive almost after every Coition, and bring forth a great Number of Young at a Time; he therefore admitted several of these Females to the same Male in one Hour, and afterwards opened them, at different Periods of Time. He observed, that as many Fœtuses as were conceived, he always found so many Cicatrices in the Ovarium, or Marks from whence the Corpora Lutea and Ova had been separated. So, also, in Cows there are as many Cicatrices observable in the Ovaria, as there are Fœtuses lodged in the Horns of the Uterus; and the same we likewise observe in Sows, who carry sometimes sixteen Fœtuses conceived at once in the Horns of the Uterus; and in Mice there are sometimes twenty. By this means *De Graaf* observed the Ovum was conveyed from the Ovary by the *Fallopian* Tube, in which he often found it; so that, after the first
Hour

Hour in which the first Ovum enter'd the Tube, there was a second follow'd, till four or five Fœtuses were thus conveyed from the Ovarium, and lodged in as many distinct Parts of the Horn of the same Side, which is always divided into as many Cells as there are Fœtuses conceived. From these Experiments *De Graaf* concludes, that also in the human Species the Ovum is impregnated in the Ovary, and from thence conveyed into the Uterus by the *Fallopian* Tube. But if the Ovum should meet with any Impediment in its Course, then the Fœtus grows either to the Tube or the Ovary. The Animals upon which *De Graaf* made these Experiments, conceive and bear their Young only in the Horns of the Uterus, of which they have two; but in the Mare and in the human Species, the Fœtus is contained in the Cavity of the Uterus itself; so that what he has observed to take Place in Animals which have two uterine Horns, may also hold true in the human Species, with this Difference, of admitting the Uterus to be the Organ for Conception: Yet it cannot be denied, but that sometimes Conception takes Place both in the Ovaria and Tubes.

§. 675. The Ovum, thus impregnated, is now retained in the Uterus, contracted or *closed*¹ by its proper *Muscles*², the membranous *Wrinkles*³ in the Neck of the Uterus assisting still farther to close its Mouth, and prevent the Ingress of any foreign Matter; to which add the thick, tenacious Juice separated by the round *Cells*⁴ here placed, and concreted almost into a kind of Paste like Starch. Thus the Ovum *swims*⁵ in the great Quantity of *Humours*⁶ which at that Time flow to the Uterus,

Uterus, and which being attenuated, or continually render'd more fluid by Heat and Motion, will enter through the *Pores* ⁷ or Vessels of the Ovum, especially in that spongy Part by which it adhered; hence the Ovum will be distended, filled, and enlarged, while within itself the Humours, being still farther subtilized by the like Causes, will nourish the Embryo, which they defend from any *unequal* ⁸ Pressure, they being confined in the Membranes of the Ovum; which Membranes by Degrees become *thicker* ⁹ and expanded, especially in that Part by which they adhered to the Ovary; whence in this Place will be formed the Rudiments of the Placenta, which seems to be nothing more than the Calyx itself of the Ovum, whose Substance it first formed, and being now increased in Dimensions every Moment, constitutes the Placenta; which is so much the larger, as the Fœtus is younger, Respect being had to the Bulk of the Fœtus.

¹ This is to be understood in a happy and true Conception; for there are an infinite Number of Cases in which the Ovum may be again discharged from the Uterus. *Hippocrates*, in his Book *De Natura pueri*, gives us such a History, and tells us the Means also by which the Ovum may be expelled, at the Time when the Fœtus may be seen by the Eye contained in the Ovum. Abortions of this Kind frequently happen without the Knowledge of the Woman, because of their exceeding Smalness; but they become sensible of an Abortion, when the Fœtus is three Months old.

² Not so much by a true muscular Force, as by a kind of Strength acquired by Inflammation in the Uterus, which is thus enabled to contract itself and close its Mouth, but without impeding the Growth of the Fœtus. That Inflammation is thus capable of causing the Parts to close and become stronger, is evident in the erected Penis, which swells and becomes hard like a contracted Muscle when distended by the influent Blood.

³ After *Eustachius*, *Morgagni*, and others, have well remarked these membranous Wrinkles or Inequalities. For the Uterus is not smooth internally; but near its Mouth there are membranous Wrinkles lying next to each other, admitting the Passage of any Thing upward, but resisting any Descent of the Ovum downward. These Juga or Pleats therefore tumefy at that Time, and close the Mouth of the Uterus, so as to prevent the Exclusion of the Ovum; which is the Business of Conception.

⁴ These Cells or Vesicles are demonstrated by *Eustachius* and *Morgagni* to be seated betwixt the Folds or Jugæ which are seated at the Mouth of the Uterus, which is often termed the Os Internum Uteri, to distinguish it from the Orifice of the Vagina. The spherical Vesicles, here seated, discharge a thick Paste-like Fluid by their proper Emissaries. Besides these, there are also Lacunæ, or mucous Ducts, seated in the same Place, which discharge a viscid Liquor. Thus these viscid Humours, discharged in a redundant Quantity by the slight Inflammation of these Parts attending Conception, become inspissated, and glue up the Os Uteri; whence we learn, that there are three Causes concurring to the Retention of the Ovum in Utero.

⁵ The Ovum therefore now fluctuates at Liberty on all Sides, as being much smaller than the Capacity

capacity of the Uterus. During this Time in which the Ovum does not adhere, it is easily dropped or expelled from the Womb; and is then, by the *French*, not termed an Abortion, but *falsum Germen*, to which they do not give the Name of an Abortion before the third Month.

⁶ The Uterus, now closed, is filled with the male Semen; together with its own mucous Juices; since Conception generally follows after the Menfes. In these Humours therefore the Ovum swims, as it is less than the uterine Cavity; and the Pores of the including Membranes of the Ovum, being thus macerated and opened, may admit the more subtil Humours surrounding them on all Sides. But hitherto, until the Ovum adheres to the Uterus, it is not termed a Foetus, but an Embryo.

⁷ They enter by that Part of the Ovum which adhered to the Ovarium, and are perhaps conveyed by the same Vessels which supplied the nutritious Humours to the Ovum, while it adhered to the Ovarium.

⁸ When a Pressure is equal on all Sides, there can be no Danger of breaking or injuring any Part of the included Ovum. If you shake the Yolk in a full Egg, it will not break, because suspended in the Middle; nor will an Egg break when included within a Bladder filled with Water, although you strike or kick about the Bladder.

⁹ These Membranes of the Ovum grow thicker, as the Uterus itself becomes thicker. For since the Uterus is composed entirely of Vessels, the Quantity of influent Juices, being now increased, must necessarily dilate the contracted Vessels, and distend the Sides of the Uterus.

§. 676. But while these Causes continue to act and increase daily, the *Bulk*¹ of the *Ovum*² and Embryo is by Degrees more and more enlarged, and, at the same Time, the Passages through the Placenta and Membranes are rendered more open; by this means the Ovum at length begins to fill the Cavity of the Uterus by its own Bulk, until its convex Surface becomes contiguous and *conjoins*³ itself to the concave Surface of the Uterus, by mutually emitting and receiving small *Vessels*⁴ betwixt each other; and this more especially in that Part of the Ovum which forms the Placenta, which there rising up into unequal Tubercles, insinuates itself into the ample Cavities of the extended Uterus, which together with the Placenta is extended every way; and in the same Proportion all their Vessels are distended or enlarged in their several Dimensions, so as to receive more Humours, and consume the *menstrual Blood*⁵, which would otherwise have occasioned a Plethora: Hence also in the same Proportion as these Passages of the Ovum grow or increase, so the Emissaries of the Uterus are proportionably dilated; so that the Cavities of these meeting with each other, the Vessels of the *Ovum*⁶ and Uterus conjoin together, and, by that means, prevent a Discharge of Lymph or Blood from the Uterus, and cause the uterine Vessels to empty themselves into the distended Ovum and its Vessels; while, on the other Hand, those of the Ovum open and empty themselves into the Vessels of the Uterus.

The

¹ The Ovum now increafes, and becomes more fpherical, till at length, by its Bulk, it fills the Cavity of the Uterus; yet it feems to continue at Liberty until its Bulk is fufficient to bring its convex Surface into Contact with the concave Sides of the Uterus, after which they grow or adhere to each other.

² By the third Month the Ovum in Utero becomes equal to a Goofe's Egg, and its included Fœtus is an Inch long. Hence it appears, that the Fœtus grows the fafter as it is fmallier or nearer its Original; for *Lewenboeck* demonftrates one of the feminal Animalcules to be hardly equal to the ten thoufandth Part of a Grain of Sand, and yet does it foon acquire the Bulk of a whole Grain, and foon after grows to a whole Inch in Length, till at the End of nine Months it weighs nine Pounds. Were we to continue thus increafing, in the fame Proportion, to old Age, we fhould weigh many Millions of Pounds; but the longer we continue, fo much the more flowly do we grow. A Child, till the Age of ten Years, grows more than betwixt ten and twenty; and from that Time to the twenty-fifth Year, the Body grows floweft of all, till it has arrived at its full Pitch.

³ The convex Surface of the Ovum fills the Concavity of the Uterus, which, being difpofed to the ufual menftrual Difcharges, has its Veffels expanded; while, in the mean Time, the Ovum becomes more mature, and is itfelf more filled and expanded with the pellucid Humours. Upon opening the Body of a Woman with Child, and carefully infpecting the Uterus, it is found adhering to the Ovum, without any Liquor interpofed betwixt one and the other; for Abortions would continually happen at all Times of Geflation, if there was any intermediate Liquor placed between the Ovum and Uterus.

4 The Ovum grows by invifible fmall Veffels, while it receives the Humours from the Uterus, as well by that Part which forms the Placenta, as by that which forms the intermediate Chorion betwixt the Ovum and Uterus. No one has hitherto difcovered, even by the Microfcope, thefe fmall intermediate Veffels; and yet, during the whole Space of nine Months, there muft have paffed through thefe Veffels more than twelve Pounds of Humours; namely, the whole Weight of the Fœtus. Even when the Ovum is feparated from the Uterus, there does not appear any Openings in its convex Surface, to determine us to think that there are any Veffels here placed; and yet certain we are, that there muft be a free Paffage from the fmalleft Arteries of the Uterus into the incipient fmall Veins of the Placenta and Chorion.

5 Women always conceive after the End of their menftrual Difcharge, and hardly at any other Time; infomuch, that we may reckon the Time of a Woman's going with Child, when in Health, from her firft Congress after her Menfes. For Inftance, if her Menfes ceafed on the fourth Day of the Month, and the conjugal Offices were performed on the fifth, ſhe may fafely reckon her being with Child from that Time; though there are many others who conceive before this Return of their Menfes: Nor yet will Things fucceed fo happily, if ſhe conceives at any other Time. For while the Fœtus is firft lodged in the Uterus, it muft needs be difturbed by the approaching menftrual Flux. Thoſe Women who are not uſed to ſuffer a confiderable Loſs of Blood by this Difcharge, feldom miſcarry; but they may eaſily deſtroy the Fœtus in the third Month, if they do not diminifh the too great Redundancy of Blood by opening a Vein: For if there ſhould be ſo much Blood diſcharged,
as

as is sufficient to interpose betwixt the Convexity of the Ovum, and the concave Surface of the Uterus, those two are then separated from each other, and a Hæmorrhage follows.

6 Every Part of the Chorion adheres to the Uterus by a true Concretion of Parts; but the Adhesion is greatest in the Place of the Placenta, for by that which was before the Calyx of the Ovum the Fœtus is principally nourished. If the Placenta continues adhering, though the Fœtus be discharged, there will not the least Hæmorrhage follow: But if the Placenta is also discharged together with the Fœtus, the Blood then flows impetuously, to the Quantity of many Ounces. In the natural Birth there is no Blood discharged, till after the Chorion and Placenta are separated from the Uterus. Hence it follows, that the Blood flows plentifully to the Surface of the Placenta; but it would be contrary to the Laws of the Circulation, for it to stop there; and therefore the Placenta seems to coalesce with the Uterus into one continued Body; so that the Fœtus lives and partakes of the same Life with the Mother, deriving all its Heat, Motion, and Nourishment, from her.

§. 677. But since the Fœtus is now joined to the Placenta by the *Funiculus umbilicalis*¹, or Navel-string, which is composed of two Arteries conveying the Humours from the Fœtus into the Placenta, and one larger Vein transmitting them from the Placenta into the Fœtus: It is therefore evident, that, by these *Vessels*², all the Humours here collected are perpetually renewed, without stagnating or inclining to Putrefaction.

¹ We are in great Obscurity with regard to the Origin of the Funiculus Umbilicalis. If you say that it arises from the Animalcule of the male Semen, and not from the Ovum, how comes it to adhere to the Placenta? and how should it send a Vein out of the Fœtus, since Veins go to the Heart, and do not lead from it? If you make it to arise from the Placenta, it is queried, how that should be able to send its Roots into the Abdomen of the Fœtus, and insert its Arteries into the Aorta? It must be confessed, this is a mysterious Affair which ever Side of the Question we take; for we here again certainly meet with the Finger of the Creator, who formed the whole Machine at once, which we are only capable of knowing and unfolding by little Pieces, and by Experiments; tho' we shall ever continue incapable of acquiring the same just Idea of the Whole, as it was at once made by the Creator. However, I must confess my Opinion to be, that the Navel-string is originally a Part of the Fœtus, being the way through which the seminal Animalcule was first conveyed into the Ovum. This at least is certain, that, before the second Month, the Fœtus appears adhering to the Placenta by its proper Navel-string; and that it is always larger in Proportion as the Fœtus is smaller and nearer to its Origin, and the smaller as the Fœtus is nearer to the Birth. It indeed gives me no small Concern, that the excellent Treasure of anatomical Preparations made by *Ruyfch*, should be lost to us by transmitting them from *Europe* into *Russia*. In this Treasure there was a Collection of Fœtuses which I have often surveyed, but always with fresh Admiration. There were human Fœtuses from the Magnitude of a Grain of Sand to the Age of nine Months. In these I found that the Ovum was larger in Proportion to
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the Fœtus, as that was younger or nearer to its Original, and smaller in Proportion to the Fœtus as it was nearer to the Birth. At first the Fœtus is near twenty Times less than the Ovum, after three Months the abortive Ovum appears larger than a Goose's Egg, but the Fœtus is hardly an Inch long. Lastly, The new-born Infant is three Times heavier than the whole Mass of the Placenta, Navel-string, and Secundines, taken all together. The Fœtus is so situated in the Ovum as to lie chiefly in its smaller End, as I have observed in an Embryo no larger than an Ant.

² The Funiculus Umbilicalis is neither membranous nor cartilaginous, but composed of strong Vessels, softer than a Cartilage, and yet in a Manner inclining to that Nature; by which means it is that these Vessels firmly retain their proper Figure and Position, without hindering them from being flexible, as is necessary from the frequent Motions of the Fœtus, and without obstructing the Course of the Blood through its Arteries and Veins. In the Navel-string there are two Arteries and one Vein, all of them twisted. Besides these Vessels, the Urachus is also added, leading to the Allantois or membranous Sack, described in the *Philosophical Transactions* by Dr. Hale: But the Vein opens into the Sinus of the Vena Portarum. Whether or no this Vein arises from the Placenta, and is rooted into the Liver, or whether it arises from thence, and passing out of the Body, afterwards implants itself into the Placenta, are Questions very difficult to determine.

§. 678. But when this mutual *Conjunction* or Communication betwixt the Vessels, and the Enlargement of them, has been extended
so

so far within the Space of two Months, that the internal emissary Tubes of the Uterus are now capable of transmitting the *Blood*² itself, and the other Tubes of the Placenta are capable of receiving it; the redundant Blood contained in the larger Arteries of the Uterus being impelled to the Placenta, seems to be drove through its dilated Vessels, changed in its Structure, and then sent to the *Fœtus*³: And this seems to be proved from the *Hæmorrhage*⁴ which happens in Abortions, or when the Placenta is separated or wounded, either in Women with *Child*⁵, or such as are in the *Delivery*⁶, as also from the Loss of Blood in the Fœtus, when the Mother only is wounded; though this seems to be opposed by the Vessels not appearing in a dead Body, and from the Continuity of the thin *Membrane*⁷ which covers the Surface of the Placenta next to the Uterus, and renders the same smooth; to which add the frequent Difference of its Bulk, being not always in Proportion to the Body of the Fœtus.

¹ The Cavity of the Uterus can admit nothing but what comes from itself and its own Arteries: But when the Uterus is impregnated, it grows larger in Proportion with the Fœtus. This is what surpris'd *Galen*; namely, that the Uterus should seem to increase in Thickness in Proportion as it was more distended or enlarged, whereas, on the contrary, all other Membranes become thin, when expanded. I would not be understood to mean that a pregnant Uterus is thicker than that of a Virgin, only that it seems to be thicker
to

to those who examine it, because it increases its Dimensions or Capacity without diminishing its Thickness. But such a pregnant Uterus is not smooth internally, but raised, in a Woman, into a kind of Tubercles, to which the rough Eminencies of the Placenta are so adapted, that they intercept each other, that is, the Protuberances of the Uterus correspond to the Sulci of the Placenta, and the Eminences of the Placenta insinuate themselves into the Excavations of the Uterus. Hence it is, that, when the Placenta is separated, there are small Cells or Cavities appear in the Uterus filled with Mucus, into which mucous Cells the Roots of the Placenta are implanted. Whether or no these are small Vessels under the Appearance of a Mucus, may be questioned; though there are many Instances, in the human Body, of small Vessels appearing under this Shape; as for Example, in the Cortex of the Brain, and the Villi of the Intestines.

² A Woman with Child discharges no menstruous Blood, which Blood is therefore sent to the Uterus only, which is thereby distended, while all the rest of the Body rather diminishes, or falls away.

³ Here we meet with a Subject much controverted betwixt the Learned; namely, Whether or no the red Blood passes immediately from the Extremities of the uterine Arteries into the Veins of the Placenta, and so into the umbilical Vein of the Foetus? that is to say, Whether the Blood has an immediate Passage from the Heart of the Mother, through continued Vessels to the Liver and Heart of the Foetus? Or, on the other Hand, Whether or no it is not more probable that Juices, thinner than the Blood, are separated from the uterine Vessels, and transmitted into the Placenta?

From

from what has been said, I think, my Opinion in this Matter may be very fairly guessed at.

⁴ Among a thousand Miscarriages which I have seen, there are hardly an hundred Instances in which this Accident did not happen about the third Month; for then the menstrual Blood is by the Mother perceived to flow from the Vagina, and if she has any Judgment in these Matters, always looks upon this as a Sign, that a consequent Miscarriage is threatened. In this Disorder the uterine Plethora not being consumed by the Growth of the Foetus, which is as yet but small, presses upon the Surface of the Chorion next to the Uterus, and separates them from each other. Now it is easy to conceive, that if there was no Communication betwixt the Placenta and Uterus, and that if sincere Blood was not afore accustomed to flow to the Surface of the Ovum, the Removal of the Chorion would not occasion a Flux of Blood similar to that of the Menfes.

⁵ When the Chorion only is divided in the natural Birth, nothing but Water flows out; but when the Placenta is separated either wholly, or in Part, an Hæmorrhage instantly follows. Is it not therefore probable, that the Blood which appeared to flow in so great a Quantity to the Placenta, is impelled into the same? Thus it would seem to be; but the Placenta is seldom fastened to the Uterus in such a Manner, as to admit of being separated without Laceration. If the Midwife offers the Placenta to your View, it is no difficult Matter to see whether the Surface of it be smooth, entire, and covered over with the Chorion; but if there is any Hæmorrhage follows, it is manifest that the Midwife used Violence in extracting the Placenta; for they even sometimes extract this Part with so much Violence, that

that there are several Instances of the Uterus itself inverted by this Means, so that the internal Surface of the Uterus has been exposed to the Air with the Placenta still adhering to it; and, in this Case, the Uterus has appeared beset with considerable Foramina filled with pure Blood; and if the Surface of the Placenta be washed and wiped dry, upon pressing the same there will appear sanguine Ducts penetrating obliquely inward. It is therefore manifest, that the Arteries and Veins of the Uterus in this Part are propagated in such a Manner, that the Blood may insinuate from them into the pervious Papillæ of *Vaterus*, and that from thence it may enter into the oblique Veins of the Placenta, and from thence it may pass through the umbilical Vein to the Liver and Heart of the Fœtus.

⁶ A Woman with Child often bleeds to Death, from a Separation of the Placenta from the Uterus, before she can be delivered. If she is invaded with this Flooding or Hæmorrhage of the Uterus in the seventh Month of her Pregnancy, the Blood will continue pouring from the distended Uterus till there is no more left in the Body, and the Woman will look as pale after Death, as if the Vessels of the Neck had been cut through; nor can this Calamity be relieved, but by extracting the Fœtus with all its Secundines. This then is a manifest Argument, that the red Blood has a free Course from the Arteries of the Uterus into the Placenta.

⁷ The Surface of the Placenta is covered externally with a solid Membrane continued from the Chorion, as *Ruyfch* discovered, and through this Membrane the Placenta transmits its small Roots. But you will, perhaps, ask, in what Manner the Blood can make itself a Way through this Membrane?

brane? This is indeed a weak Objection; for in Hæmorrhages the Blood flows from the Uterus even till the Mother expires, and yet we cannot perceive the Mouths of those Vessels which discharge the Blood. Since the Placenta is covered with the Chorion, which manifestly unites to the Uterus by hollow vascular Villi, I think there can be no doubt in this Affair. For in the same Manner we have an Account of an *English* Gentleman, who had every Month a plentiful Discharge of Blood from the Skin of his Finger, though it was manifestly covered with the Cuticle, and had no apparent Vessels extended beyond the same. Thus also the Woman at *Amsterdam* discharged her menstruous Blood, under the Form of Sweat, through the Pores of the Skin of her Head covered with Hair, without any manifest Appearance of Vessels. On the other Hand, we have an Instance of a Bullet making its Way through the Skin without causing any sensible Wound, by raising or extending the same, first into a Tubercle, afterwards adhering thereto, till, by Degrees, the Integuments were extenuated, and a Passage made for it without injuring any of the subjacent Parts. We are also furnished with many Instances of Vessels in the Body, which are capable of very great Distension, and of contracting themselves again afterwards. The Os Uteri is in its natural State close shut or contracted, but at the Time of the Birth it dilates so as to transmit the Infant. The Sphincter of the Anus contracts itself so closely as to retain a Clyster, and yet does it afterwards dilate so as to exclude the large Lumps of indurated Fæces in People who are subject to be costive. From what has been said, I think it is manifest, that Part of the arterial Blood of the Mother, having suffered the Action of the Lungs,

passes

passes into the Placenta of the Foetus, and from thence to the Liver, Heart, and several Parts of its Body.

§. 679. For the whole *Body* ¹ of the Placenta being furnished with *innumerable* ² Arteries dispersed every way without putting on the Appearance of Glands, much as in the cortical Part of the *Brain* ³, is also supplied with Veins interwove like the former, together with lymphatic *Cells* ⁴ and Vessels; of all which it is chiefly made up, being covered with a *thin Membrane* ⁵, which may be easily lacerated, and, by a gentle Pressure on the recent Placenta, transudes bloody Spots through an infinite Number of oblique Ducts, which, together with small Drops of the other Juices, and also the oblique Vessels themselves may be distinctly viewed by the Microscope; and this Membrane, continued from the Chorion, is extended over the convex Surface of the Placenta, which adheres to the Uterus. Hence the Placenta, being placed betwixt the expanded Membranes of the Chorion, is thereby covered on each Side. It receives two *Arteries* ⁶ from the lower Part of the descending Aorta, which, being reflected back to the Navel of the Foetus, do there pass out in a cartilaginous *Substance* ⁷, which supports and strengthens the Veins of the *Funiculus* ⁸ *umbilicalis*, or Navel-string, lest they should become unfit to return back the Blood, which is become too thick to circulate freely in the Foetus. But the

the Origin of the *Veins* ² of the Placenta is so obscure that they cannot be demonstrated; yet all of them are collected into one Trunk, which likewise passes through the Funiculus Umbilicalis. Certainly the Arteries and Veins in the Body of the Placenta have their Branches thus disposed by the Sides of each other, and are included together in the same thin membranous Case for evident Reasons: This Vein entering by the Navel of the Fœtus, ascends through a Fissure in the Middle of the lower and anterior Part of the Liver; from whence it passes into the larger Sinus of the Vena Portarum, into which the umbilical Vein discharges all its contained Blood; but in such a Manner, that, opposite to its Entrance in that Sinus, another Vein opens, and discharges itself directly into the Cava, where it is connected to the Diaphragm; so that this Vein may send Blood either into the Liver or Cava, and thence it may easily pass to the Heart, to be by that distributed, agreeable to the Laws of Circulation, throughout every Part of the Body of the Fœtus.

¹ The Corpus Luteum, through which the nutritious Juices of the Ovary are transmitted to the Ovum, turns afterwards into the Calyx or Footstalk of the Ovum; and after this it becomes the Placenta, when the Ovum adheres to the Uterus. In this Placenta is rooted the Navel-string of the Fœtus, or rather Embryo, which does not adhere to the Mother any other way than by the Placenta, which must be excluded together with

with the Fœtus, notwithstanding it very strongly coheres to the Uterus, and is with Difficulty separated from thence even in a dead Body. There are three Kinds of Placentæ found in Animals : 1. In the human Species, and a few Brutes, there are innumerable Cotyledons compacted together into one Mass, or Placenta. 2. But in the Cow, Sheep, Goat, &c. the Cotyledons are spread distinct from each other through the Chorion ; tho' from all of them arise Branches, which form but one umbilical Vein, two Arteries, and one Urchus, as in the human Species. For these Cotyledons are no more than one Placenta divided perhaps into an hundred Portions, or Tubercles ; something like which are to be found in the Placenta of a Woman, but so closely compacted together, that they form one Mass ; yet are they not so strictly concreted together, but that they may be separated by Art. 3. Oviparous Animals have a hard Shell with which the Chick is defended, together with Membranes lining the Shell, answering the Chorion and Amnios ; to which add the Albumen for the Nutrition of the Fœtus in Ovo, with the Yolk or Placenta, and the Sacculus of Colliquamentum seated in the Middle of the Yolk, and including the Fœtus itself. But the Navel-string is derived from the Navel of the Fœtus passing through two Membranes, and rooting itself in the Yolk. Here the Yolk is the Calyx or Footstalk of the Ovum, and is not itself consumed till the Chick is hatched ; but the Ovum is so formed, that all the Aliment, namely, the Albumen, must pass through the Yolk to the Fœtus ; where, being elaborated, it is at length transmitted by the Funis Umbilicalis to the Liver, for nourishing the Chick.

² It is no easy Matter to describe the Placenta. *Ruyſch*, who ſo frequently injected the Body of the Placenta by the Navel-ſtring, found, that no Part of it could be divided without wounding the Veſſels diſtended with ceraceous Injections. Upon injecting one of the umbilical Arteries, he, by that means, filled all the Veins: And, on the other Hand, by injecting the Vein, he filled all the Arteries. The Placenta being thus filled, he ſuſpended it in warm Water, by which means only the Veſſels were preſerved entire from being corrupted by virtue of the Injection, all thoſe Parts being deſtroyed by Putrefaction, which were not filled with the ceraceous Injection; by this means the Placenta appeared to be made up of ſanguiferous Arteries and Veins only, admitting the red coloured Injection, and looſened from each other by macerating in warm Water.

³ That is to ſay, from one arterial Branch an infinite Number are ſent out, into all which the Injection enters, and demonſtrates the Termination of the Artery: For the reſt of the Placenta, which is more than the Veſſels, before it is diſſolved appears one confuſed red Maſs; but if you diſſolve that, the Veſſels only remain, and all the reſt is deſtroyed, as in macerating a Portion of the Brain. Laſtly, An ultimate Branch of the Arteries of the Placenta divides itſelf, at laſt, into a great Number of ſmall Ducts or Branches incredibly minute, ſo as almoſt to reſemble a Pencil-bruſh coming out of its Quill; and the ſame is likewise true of the ſmall Veins.

⁴ A Girl, of a fine Habit of Body, was delivered of an Infant healthy enough, but the Placenta appeared on all Sides full of Follicles or Cells, the Cavities of which were filled with round Stones; and in the ſame Manner *Ruyſch* obſerved, at another Time,

Time, that the Placenta was changed into Hydatides or Vesicles filled with a pellucid Water, which congealed or hardened with Heat. These Follicles are destroyed in preparing the Placenta by Maceration, or even by washing it; nor do they appear but in a morbid State. It is sufficiently manifest, that these Hydatides are lymphatic Vessels, and that there are perhaps all the decreasing Series in the Placenta, both Arteries, Veins, and Lymphatics, with almost every other kind of Vessels.

Of such a Nature, that nothing seems capable of passing to the Placenta. When a Woman is deliver'd at her full Time, and in the natural Way, she does not force out the Fœtus naked, but in the Sacculus, in which it is included, on all Sides, like an entire Ovum; and such an Ovum, discharged from a Woman used to play upon the Harp, is very well described by *Hippocrates*. The external Covering of this Ovum is twofold; the membranous Chorion, and the Placenta; over which is spread, round the whole Ovum, a thin Covering, which, when arrived at the Placenta, divides itself into two Pleats. The exterior Lamella of this Membrane, passing over the Margin of the Placenta, is spread upon its convex Surface betwixt the concave Part of the Uterus: The other interior Pleat of the divided Chorion is spread betwixt the Placenta and Fœtus, and is then connected to the Membrane Amnios; so that the Chorion contains the Placenta betwixt its Duplicature; which is a manifest Argument that it belongs not to the Mother, but to the Fœtus, although the Embryo at first with its Placenta, and even the whole Ovum, was a Part of the Mother's Body. By this Placenta only the Fœtus is connected to the Mother,

nor was there ever any other Vessels found communicating betwixt the Mother and Fœtus.

⁶ The iliac Arteries arising from each Side of the Trunk of the Aorta at the Loins, do each send out a Branch or Artery, which seems to arise likewise from the Aorta itself; from whence these Arteries ascend from their Trunk to the Navel, under the interior Lamella of the Peritonæum; and, passing out of the Abdomen of the Fœtus, they enter the Navel-string, and are at last implanted in the Middle of the Placenta. By injecting these Arteries, the whole Placenta is filled. There is no doubt but these Arteries convey Blood from the Fœtus to the Placenta; all that can be questioned is, Whether the Blood which they convey continues in the Placenta? which is a Question we shall next consider. All Vessels which are continued in a direct Course from their Origin, convey their Humours more in a right Line, which renders them more retentive of their Motion. If a Gun is loaded with a Piece of Lead, the heaviest of Metals next to Gold, together with a Piece of Copper, Iron, and Wood; if then the Gun be discharged in a Place where you can observe how far the several Bullets are thrown, you will find the wooden Bullet nearest to the Piece, and the leaden one farthest off. In the same Manner the Blood, descending through the Aorta, strikes upon the iliacal Arteries, and has a Tendency from thence into the lateral and retrograde umbilical Arteries. Into these, therefore, will enter those Parts of the Blood which, according to the Rules of Hydraulics, are the least able to continue their Motion in a right Line; and this most viscid and fœculent Part of the Blood of the Fœtus will be conveyed, by the umbilical Arteries, to the Placenta. But the Placenta returns to the Fœtus, either that Blood
which

which came by the umbilical Arteries, or else some of the Mother's Blood received from the small uterine Arteries into the Veins of the Placenta. But either of these Kinds of Blood pass through the umbilical Vein into the Body of the Fœtus, as well that which came from its own Arteries, as the most subtil and pure Blood derived from the Mother. Now most Anatomists teach, that the Blood conveyed into the Placenta by the umbilical Arteries, is there altered or changed, as if it received the Action of the Lungs, which are at that Time idle in the Fœtus; and that therefore the Placenta attenuates the Blood like unto the Lungs in a Person who breathes. Hence therefore they say, the most fœculent and thick Parts of the Blood are conveyed from the Fœtus to be attenuated by the Fabric of the Placenta, and, after passing through its Vessels, it returns again to the Fœtus: For certain it is, that the Blood appears more thin and fluid in the umbilical Vein than in the Arteries. But, for my own Part, I am apt to believe this Change is rather made in the Mother herself. I do not indeed deny that the Fœtus is capable of making Blood to itself from a Liquor which is not yet sanguine, in the same Manner as the Chick in the Egg makes its own Blood, without being capable of receiving any from the Mother. This Blood of the Fœtus is conveyed thro' two excretory Canals or Arteries of so large a Capacity, that the Fœtus bleeds to Death in a few Hours, if the Midwife forgets to tie them at the Birth; of which I remember an unfortunate Instance three Years ago here at *Leyden*. These Arteries therefore receive a great Quantity of Blood from the Fœtus, which passes thus copiously to the Placenta, because it finds there a less Resistance than in the Body. In the Placenta this Blood

seems to pass immediately from the Arteries into the Veins, since a ceraceous Injection, thrown into the umbilical Arteries, returns through the Vein. But besides this Blood returning to the Fœtus, there seems to be some Part sent from the ultimate small Arteries of the Placenta into corresponding small Veins in the Uterus of the Mother; from whence it passes again into the larger Veins, and by them into the Lungs and Heart, that the Blood which in the Fœtus suffers no Action with the Lungs, may, by this Return, be elaborated in her Lungs: But the Blood of the Mother, after being attenuated by the Lungs, seems to return again, through small Arteries of the Uterus, into the corresponding Veins of the Placenta, that thus as much prepared Blood may be restored from the Mother to the Fœtus, as she received crude and imperfect Blood from the Fœtus. Nor do I believe the Placenta capable of performing the Action of the Lungs, which themselves do not attenuate the Blood when at Rest, and deprived of Air: But the Placenta has neither Air, nor any Agitation, to forward the Course of the Blood, which therefore seems to be rather retarded than accelerated thro' this vascular Compages; for the Blood, which is capable of pervading the resisting Mass of the Placenta, might with much more Ease, and less Resistance, circulate through the Body or Fœtus itself.

⁷ The Navel-string is that Part by which the Fœtus communicates with the Placenta, being almost of a cartilaginous Nature, and so flexible that it easily yields every Way. It first perforates the internal Lamella of the Chorion, then penetrates the Amnios, and so passes to the Fœtus.

⁸ The Placenta is composed by an Assemblage of Vessels, sanguiferous, serous, and lymphatic, covered

covered with a cellular Membrane, as appears from the Hydatides, into which the Placenta has been sometimes obliged to change itself, and which are a manifest Argument that there are empty Cells or Spaces betwixt the Vessels.

9 The Veins arise from every visible Point, both external and internal, of the Placenta, by small Roots ; which, being dispersed gradually, unite into larger Veins, meeting at last all together in one Trunk, which being destitute of Valves, may, by the *Ruyschian* Art of injecting, be filled, so as equally to distend the whole Body of the Placenta. When this Vein enters the Navel-string, it goes on to the Center of Gravity of the Fœtus, namely, to the Navel itself, where the Cuticle, which covers the whole Body of the Fœtus, is not perforated, but extended or continued round the Navel-string, so as to compose its first Covering ; and the reticular Body of *Malpighi* is likewise extended in the same Manner. In the next Place, the Skin itself is not perforated, but ascends, like the former, in a hollow Cylinder round the Navel-string, and composes its second Covering. But the Skin itself is likewise accompanied with the cellular Membrane which ascends round the Navel-string, which then enters betwixt the recti Muscles of the Abdomen, where they recede from each other ; and from thence it passes under the Peritonæum, a Membrane composed of two Lamellæ or Plates, betwixt which twenty Pounds of Water are capable of being received, as we know, by Experience, in Dropsies. The Navel-string therefore, having reached the exterior Lamella of the Peritonæum, that is to say, its cellular Membrane, enters into it, and is thereby surrounded, continuing its Course betwixt the two Lamellæ of the Peritonæum to the anterior Fissure of the Liver without perforating the inner-

most Lamella; which is properly the Peritonæum itself; at this Fissure of the Liver, the Peritonæum recedes, and the umbilical Vein continues on its Course by itself, till it opens into the Sinus of the Vena Portarum. The Vein now mentioned, serves to convey the Blood from the chylicative Viscera of the Fœtus. Add to this the Blood which comes from the Placenta, and the Liver will appear to be supplied with more Blood than it can admit; and therefore we observe a Tube continued from the Sinus of the Vena Portarum, and opposite Extremity of the umbilical Vein directly into the Vena Cava, which returns the Blood from the lower Parts of the Heart. Nor is the Cava thus overcharged with Blood, since it does not return all the Blood which was sent from the Heart by the Aorta into the iliacal Arteries, which has been diminished by the Quantity received from thence through the umbilical Arteries: Thus the lower Trunk of the Cava receives less Blood than passes through the Aorta; but then this Defect will be supplied by the Blood which comes through the umbilical Vein. If now, from any Cause, the Motion of the Blood is accelerated through the Vena Cava, and, by that means, resists the Blood which is derived from the umbilical Vein, the Blood of that Vein may then pass through the Liver, in Proportion as that affords a less Resistance than the Cava: But whenever the Resistance of the Cava is less than the Vena Portarum of the Liver, then the Blood may pass directly from the umbilical Vein into the Cava; and if the Resistances of the Vena Cava and Liver are equal, then an equal Quantity of Blood may pass to the Liver and to the Cava; and this seems to be altogether the Reason why Nature chose rather to send the Blood of the umbilical Vein into the Sinus of the

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Vena Portarum, than immediately into the Cava; but as it is at present, mediately or immediately, the Blood of the umbilical Vein is always returned into the Cava.

§. 680. Now the Blood derived from the whole Body of the Foetus and umbilical Vein, being poured into the *venous Sinus*¹, and arrived almost at the right Auricle, it there descends partly into the Heart, as in adult Persons, while the *other Part*² strikes against the intermediate Partition betwixt the two Auricles; in which Partition there is an open Foramen of an oval Figure, upon which lies a membranous *Valve*³ or Covering, so disposed as to open towards the Cavity of the left Auricle; whence it appears, that this Portion of Blood passes thus, from the right into the left Auricle, so long as the Lungs are not in Action; or at least, that the Blood thus passes from the venous Sinus of the Cava, and next adjacent Parts of the right Auricle into the venous Sinus of the pulmonary Vein.

¹ Where the Liver unites to the Vena Cava, there the Cava always adheres to the Diaphragm, which constricts that Vessel like a Valve; but immediately after the Cava has passed through the Diaphragm, it becomes a large Sinus, into which the Blood of the Vena Azygos, and of the Cava superior and inferior, is conveyed.

² All the Blood from the superior Cava passes into the right Sinus, while the inferior Cava brings not only the Blood from all the lower Parts of the Foetus, but also the Blood of the umbilical Vein
derived

derived in the same Quantity from the Placenta, as was sent thither by the umbilical Arteries of the Foetus. Thus equal Quantities are conveyed to and from the Heart in equal Times; but if more Blood arrives to the Heart of the Foetus than is sent from it in a given Time, a fatal Plethora must soon follow; but if the Quantity of Blood returning to the Foetus is less, a Syncope, and its Consequences must follow from the Deficiency of the Blood. Hence it follows, that the Vena Cava, in a natural State, must return as much Blood to the Heart as was conveyed from it by the Aorta to the Body of the Foetus and Placenta. But now the Heart in a Foetus continually acts, though the Lungs are at Rest; and therefore, when the right Ventricle discharges its Blood, then the right Sinus and Auricle, being filled, will urge their Blood where there is the least Resistance: But the right venous Sinus lies close to, and is only separated from the Sinus of the pulmonary Vein by a Membrane, which is perforated with an oval Opening from one Sinus to the other, over which Opening there is a pendulous Membrane moveable towards the Lungs like a Valve, which shuts towards the Cava. If now there is a less Resistance in the left Sinus than in the right, then the Cava, distended with Blood, will continue to send its Contents this way into the pulmonary Vein, till the Resistance there is equal to that of the right Auricle itself, after which no more will enter; and therefore the Portion of Blood derived through the Foramen Ovale will be equal to the Quantity by which the Blood of the right venous Sinus exceeds that of the left. But since the Sinus of the Cava and pulmonary Vein are equally capacious, there will be an Equilibrium betwixt them, when they receive equal Quantities of Blood; while the
rest

rest of the Blood from the Cava, continues its Course through the right Auricle and Ventricle of the Heart. But it now remains for us to assign the Reason, why less Blood is contained in the pulmonary Vein than in the Cava. The Area or transverse Section of each Vein is equal; but the Difference proceeds from the Lungs, which in a Foetus transmit no more Blood, in Proportion to their Bulk, than any of the other Viscera; namely, a tenth Part of the Mass, if the Lungs are equal to one tenth Part of the whole Body. If now the Lungs receive but one tenth Part of the Mass of Blood, the Sinus of the pulmonary Vein can receive no more than that Quantity, whence there would be ten Times less Blood in that Sinus than in the right; and therefore the Blood flows with a greater Impetus from the right Sinus of the Vena Cava through the Foramen Ovale into the left Sinus, till an Equilibrium is made up betwixt them both; and, on the contrary, if the Blood was to be derived in a greater Quantity, as it cannot in the left Sinus, there is no doubt but it would pass the same Way into the right Sinus, till an Equilibrium was produced. Hence, therefore, the natural Course of the Blood is from the whole Foetus through the Vena Cava, partly into the right Auricle and Ventricle, and partly through the Foramen Ovale, into the left Sinus of the pulmonary Vein. This Consideration only might have convinced the celebrated *Mery*, if he had not prejudiced his Way of thinking in Opposition to *Du Verney*, and might have put an End to the Doubts of the *Parisian* Academy, when they hesitated betwixt the Opinion of *Du Verney* and *Mery*.

³ The Position and Connection of this Membrane by its Fibres demonstrate, that it can more easily

easily permit the Blood to pass from the right to the left Sinus, than from the left to the right: But the same Consequences will follow, provided it is equally moveable either way.

§. 681. That Part of the Blood from the Cava which enters the right Auricle and Ventricle of the Heart, is, by the muscular Force of the latter, pressed all of it into the Trunk of the pulmonary Artery, which in the then collapsed Lungs, must afford a very great Resistance, whence the Blood will dilate that Part of the arterial Trunk most, which is at Liberty from the Lungs; and from hence it is, that this Part of the pulmonary Artery often appears larger than the Aorta; after this a small Quantity of the Blood passing through the Arteries of the Lungs slowly, will prevent them from growing together, and increase or extend them in Proportion to the Growth of the Fœtus; but then from the pulmonary Arteries, this Blood will pass through the pulmonary Veins, and mix itself with the Blood admitted through the Foramen Ovale; as evidently appears from the Situation, Connection, and Course, of the Valve fastened to the same oval Foramen, admitting a Passage from the Cava into the pulmonary Vein, but not the Reverse: Nor is this Entrance opposed by the small Quantity of the slowly moving Blood already arrived here through the Lungs; therefore, both these Kinds of Blood will be drove from the Sinus of the pulmonary Vein into the left Auricle, and from thence into the left Ventricle;

Ventricle: But the greatest Part of the Blood drove from the right Ventricle into the pulmonary Artery, there meets with the open *Canalis Arteriosus*, all the way of an equal Diameter, passing a little obliquely from the pulmonary Artery to its Entrance into the Aorta; and therefore, by this Canal, so much Blood passes from the pulmonary Artery into the Aorta, as the Blood of the Aorta affords a less Resistance, than the collapsed *Lungs*. But the Blood drove from the left Ventricle of the Heart into the Aorta, thus mixes itself with the Blood drove from the right Ventricle (through the pulmonary Artery, and *Canalis Arteriosus*) into the same Aorta as before described; so that thus the Blood of the Fœtus appears to pass on destitute entirely of the Action of the Lungs, which it nevertheless stands much in need of: To supply this Defect, therefore, the most subtil Part of the arterial Blood, separated from the uterine Vessels of the Mother, is sent into, elaborated, and retarded, in the small Veins of the Placenta, from whence it is forwarded by the Vibration or Diastole of the umbilical Arteries in the same Placenta, and in the Navel-string through the umbilical Vein, till, at last, it thus continually mixes itself with the venal Blood of the Fœtus, returning to the Heart, to be from thence, soon after, distributed through all the smallest Arteries of the Body: On the other Hand, the grosser Part of the arterial Blood of the Fœtus, is, by a mechanical Necessity,

cessity conveyed in an opposite Course through the umbilical Arteries to the breathing Mother, to be again attenuated; while, in the mean Time, there is a kind of Obstacle or Remora made to this Course by the Fabric of the Placenta, as a Security towards the Life of the Fœtus, in Proportion to its Bulk, and the Largeness of these Vessels.

By a Parity of Reasoning we see, that the Lungs can thus only receive a tenth Part of the Mass of Blood proportionable to their Magnitude; all the rest of the Blood received from the right Ventricle of the Heart by the pulmonary Artery, being denied a Passage through the Lungs, whose Substance is then a compact Mass like the Liver, and, upon being thrown into Water, always sinks to the Bottom: But the Blood, once received in the pulmonary Artery, cannot return back again into the Heart, that being prevented by the respective Valves; and therefore, to remedy this, we observe an intermediate arterial Canal, passing from the pulmonary Artery of a Fœtus into the Aorta, in that Part where these two Vessels lie close to each other, in such a Manner, that the lower Part of the Canal belongs to the pulmonary Artery, and the upper Part to the Aorta. Thus, therefore, the Branches of the pulmonary Artery receive a Quantity of Blood proportionable to the Magnitude of this Viscus; but the rest of the Blood which is incapable of passing through the Lungs now calapsed, will all force itself a Way through the Canalis Arteriosus into the Aorta, where it finds a less Resistance than in the Lungs. Thus the Lungs receive and transmit a very small Portion of Blood in the Fœtus, agreeable to their Bulk in a collapsed

fed State; whereas, in an Adult, they transmit the whole Mass of Blood derived from the superior and inferior Cava; which Mass in the Fœtus is lessened by these Passages of the Foramen Ovale and Canalis Arteriosus: So that, notwithstanding this Obstacle to the Blood's Course through the Lungs in a Fœtus, the left Ventricle of the Heart and Aorta do, nevertheless, receive their due Quantity of Blood. Hence the Circulation of the Blood becomes equable, as in Adults; nor is there any other Difference in its Course, except that a large Portion is conveyed, by the umbilical Arteries, from the Aorta to the Placenta of the Fœtus.

§. 682. But, in the mean Time, a nutritious lymphatic Humour is *prepared*¹ in the other *small Vessels*² of the Uterus, and being render'd extremely subtil, it is at length propelled from the uterine Ducts through the Pores of the Chorion, in whose Vessels it is still farther elaborated or changed; and passing from thence into the small Ducts of the Amnios, it is there farther perfected, and at last distilled into the Cavity of that Membrane, from whence it is drank up by the Mouth, and swallowed into the Stomach of the Fœtus; there again it is digested, and mixing with the Saliva, pancreatic Juice, Bile, and intestinal Humours, it then passes, under the Form of *Chyle*³, to be absorbed by the lacteal Vessels, while the viscid Fæces are, by the Motion of the Intestines, thrust down even to the Sphincter of the Rectum, and from thence upward accumulated and condensed, throughout the whole Tract of
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the Rectum, Colon, and Cæcum, without being capable of a Discharge, because the contractile Power of the Sphincter cannot be overcome while there is no Act of Respiration; and from hence it is that we generally find, when the Fœtus is perfect or mature, that the whole Tract of the large Intestines before-mentioned is filled with the Mæconium or fæculent Parts of the forementioned Humours.

The Humours are urged, with an incredible Force, through the Uterus, but their Motion is slow; whence they seem to be digested and changed by the Heat, which is equal to that of a sitting Hen. These Humours are almost entirely Blood and Chyle, as is evident; because the same Humours which flowed to the Uterus, the Day after the Birth, flow to the Breasts, and are very much like to the Chyle. The uterine Humours therefore continue to be moved and changed, till they acquire the Nature of a nutritious Liquor like Chyle, which being conveyed to the internal Surface of the Uterus, where it adheres to the Placenta, it then passes through the Veins of the latter into the Fœtus by the Trunk of the umbilical Vein. But Authors of the best Repute have observed, that the Chorion becomes contiguous to the Uterus itself, in that Part where it does not encompass the Placenta, from which it is also free; so that there is no Distance left betwixt the concave Uterus and convex Ovum, the whole Surface of the Ovum and the Uterus coming into Contact on all Sides. For if the least Quantity of Humours be interposed, a Miscarriage must necessarily follow. Add to this, that the Placenta is covered over by the Chorion, and therefore in that Part where they are contiguous,

contiguous, all the Humours must pass from the Uterus through the Chorion, before they can enter the Foetus from the Placenta. Now at the Time when the Foetus was first conceived, it was an exceeding small Particle, which in the Space of nine Months has grown or enlarged itself in an incredible Proportion; but all this Increase was derived from the Uterus, and that through the Chorion, which must be therefore a Membrane furnished with Pores corresponding to those of the Uterus; besides which, we know not any other Means whereby the Humours can be transfused from the Mother to the Foetus through the Placenta. I do not pretend here to teach the Fabric or particular Mechanism by which this Membrane operates, for with this we are unacquainted, though assisted with the best Microscopes; yet are we nevertheless equally certain, that the alimentary Juices are conveyed to the Foetus through the Chorion, which ever way that be effected. But there is a twofold Passage through the Chorion, the one into the Placenta, and the other into that Part of the Ovum in which there is no Placenta: For, as we said before, there is no Part of the Uterus but what is covered by the Chorion internally; nor is there any intermediate Space betwixt the Uterus and Chorion, for this would give Rise to Superfætation, which is therefore brought as an Argument to demonstrate, that the Chorion is sometimes at Liberty, though this is an Accident very rarely happening. The Humours therefore from the pulpy or vascular Substance of the Uterus, enter through that Part of the Chorion, where there is no Placenta; and from thence they pass into the Amnios. There is therefore a twofold Juice transuding from the Uterus through the Chorion; the one Blood, which passes through the Body of the Placenta to the

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Foetus,

Fœtus, and the other the Liquor of the Amnios, which comes from the Uterus through the Chorion, and transfuses into the Cavity of the Ovum, where it forms that aqueous Humour in the midst of which the Fœtus swims.

² Which Vessels are so small, that we do not perceive the least Appearance of them, when the Uterus is not gravid. These small Vessels of the Uterus grow larger from the first to the last Instant of Gestation; for the Uterus is extended into a larger Compass, and in Proportion its small Vessels are also distended and enlarged. Hence it is, that the Uterus, which is exceeding thick in a Virgin, does nevertheless retain the same Thickness, though vastly enlarged or distended in a Woman with Child; nor does this Thickness arise from an Addition of new Vessels to the former, nor from any Addition to the Number or Bulk of the solid Parts, only the Vessels themselves are more distended by an increased Quantity of Humours sent into them. But as the Pores of the Uterus are distended, so must likewise the Pores of the Chorion be distended in the same Proportion.

³ The Liquor of the Amnios is never deficient, and must be therefore perpetually supplied, nor does it ever contract any Acrimony or ill Smell, being perpetually renewed; and it is therefore truly a nutritious Humour, which being elaborated in and transmitted through the uterine Arteries of the Mother, is received by the bibulous Ducts of the Chorion and Amnios, and from thence conveyed into the Cavity of the Ovum, for suspending the Fœtus. The Taste of this Liquor is soft, sweet, and saltish; of an agreeable Smell, congealing with the Heat of boiling Water, or in a Spoon over the Fire; but not so readily as the White of an Egg or the Serum of the Blood, to which last
it

it nearly approaches in its Nature, or resembling the White of an Egg diluted with Water. The Use of this Liquor is twofold; namely, to contain and to nourish the Fœtus. We are by many Arguments induced to believe, that this Liquor is taken to nourish the Fœtus by the Mouth; for every Fœtus, even while contained in the Uterus, sucks the Finger of the Midwife, if she can put it into the Mouth; and a new-born Infant, opened after Death, has always its Stomach full of a Curd-like Mass, as if it had lived upon the Whites of Eggs, while all the small Intestines are filled with the same alimentary Mass, and all the Lacteals appear replete with Chyle. A Woman here at *Leyden* was delivered of a Fœtus, which, by the Misconduct of the Midwife, had the Integuments of its Abdomen lacerated, so that the Intestines appeared pendulous through the thin Skin of the Peritonæum, and the Motion of the Chyle might be seen, by the Eye, flowing from the small Intestines through the Lacteals, though the Fœtus had never received any other Aliment but this Liquor. Thus therefore the Stomach and small Intestines in a Fœtus, perform the same Office as they do in an Adult; the Creator thinking it necessary to accustom these Parts by degrees to that Office, in which they were to be afterwards employed during Life. This nutritious Matter is a Humour, which transudes through two Membranes, in the same Manner as the Albumen in an Egg is first transmitted through the Yolk, and afterwards through the Amnios into the Sacculus of Colliquamentum. The Fœtus is therefore nourished, agreeable to the ancient Doctrine of *Hippocrates*, by Blood conveyed thro' the umbilical Veins, and by the Liquor of the Amnios received through the Mouth. The Reason of this twofold Manner of Nutrition is

as follows: No Animal can generate red Blood but by the Efficacy of the Lungs, or the Branchia, or Gills, which in Fish are analogous to the Lungs of terrestrial and amphibious Animals; so that although Chyle and the rest of the Humours may be prepared by the Fœtus, yet red Blood cannot be generated, because the Lungs are quiescent. And yet we find, that the Fœtus contains red Blood as well as an Adult. Hence then it seems to follow, that Part of the Blood and Humours, which in a Fœtus are destitute, and stand in need of the Action of the Lungs, are conveyed through the umbilical Arteries to the Uterus, and from thence to the Lungs of the Mother, to undergo their Action and Efficacy: But then as much Blood returns from the Mother through the Placenta and umbilical Vein, after being attenuated by the Lungs, as is proportionable to the Quantity sent from the Fœtus through the umbilical Arteries to the Mother; so that the Fœtus is not so properly nourished by the umbilical Vein, as it may be said that way to receive the Benefit of the Mother's Lungs. But the true Nutrition of the Fœtus is carried on by a Humour which it receives through the Mouth and Nose, which in the new-born Infant appear to be filled with this Humour, which, mixing with the Bile and pancreatic Juice in the Duodenum, is by that means prepared and afterwards received into the lacteal Vessels of the Fœtus, from whence it passes by the thoracic Duct into the Vena Cava and right Ventricle of the Heart; from whence again it passes partly through the Lungs, partly through the Foramen Ovale, and in part through the Canalis Arteriosus into the Aorta, and all the Arteries of the Body; and from thence again the more crude and viscid Parts of this Blood are conveyed by the umbilical Arteries through the Placenta

centa to the Mother, who returns as much good Blood to the Fœtus by the umbilical Veins, as she received crude by the Arteries. In a Word, Chylification is performed in the Fœtus itself; but Sanguification is, for the most part, carried on by the Lungs of the Mother.

§. 683. But since the Fœtus receives into its Intestines the *Saliva* ¹ and *Mucus* ² by Deglutition, with the Bile and other Humours, all which deposit some *Fæces* ³; these, being added to the Recrements of the preceding Liquor (§. 682.), will increase their Bulk, and change their Qualities or Appearance.

¹ The Saliva flows plentifully from the Mouth, and is continually swallowed by the Fœtus, to promote its Chylification; to assist which, also, the pancreatic Juice seems to be separated in great Quantities. For the mesenteric Glands in a Fœtus are much larger than in an Adult, and both the Thymus and Breasts are more turgid than the Breasts of a Woman who gives suck; and in the same Manner all the Glands throughout the Fœtus are larger in Proportion to the rest of the Body. All these Glands indeed separate pure Juices, which yet, by Heat and Stagnation, deposit Fæces, and, together with the Recrements of the Liquor Amnii, compose the Matter of the Meconium, to which is communicated a dark green Colour, by the Bile flowing in large Quantities into the Intestines.

² The whole Cavity of the Fauces, Nostrils, and Surface of the largely expanded *Schneiderian* Membrane, appear, in the Fœtus, to be filled on all Sides with Mucus.

³ By the third Month we observe, that the Fœtus has Excrement in its large Intestines, always more in Quantity, in Proportion as it is nearer to the Birth. When the Fœtus is killed before it has breathed, we then find the whole Colon with its sigmoide Incurvations, together with the Cæcum, Appendicula Vermiformis, and lower Part of the Ilium, are filled with Excrements, which, from their Consistence, black Colour, and particular Tenacity or Fatness resembling the Juice of Poppies, have been all along denominated Meconium from the Ancients down to the present Time; this Name being received even by *Celsus* himself, the most elegant and refined of the *Latin* Writers in Physic. From these Appearances we justly conclude, that, from the third Month of Gestation, the Fœtus begins to digest and form Chyle from the Liquor of the Amnios, which, with the other Juices conveyed into the Intestines, affords an Excrement, which, not being transmitted to the Mother, is collected in its proper Storehouse or Repository, the large Intestines. Hence it is, that the Appendicula Vermiformis appears so much distended in a Fœtus. Yet are not these intestinal Fæces permitted to escape through the Sphincter of the Rectum, whose Resistance cannot be overcome without the Help of Respiration; but the very Instant when the Fœtus first inspires the Air, it immediately unloads the Intestines: And therefore a Discharge of the Meconium is always esteemed a true Sign in Delivery that the Fœtus has breathed, and will be in imminent Danger of Suffocation if not instantly delivered; but in the Uterus these Fæces were never known to be deposited.

§. 684. Now the Kidneys of the Fœtus are at the same Time very large, and much *greater*¹ in Proportion to the Body than in Adults, being composed of an *Assemblage*² of distinct Portions like lesser Kidneys, which continually separate and distil a small Quantity of Urine, not *acrid*³, which is continually but slowly sent through the Ureters to fill the Bladder; but the Discharge of this urinous Liquor thro' the Urethra, is entirely prevented by the Resistance or Contraction of the Sphincter, which is not to be overcome but by the concurring Force of *Respiration*⁴: But when this Liquor abounds, it passes through a membranous Canal, leading from the Fundus of the *Bladder*⁵, and ascending upward, goes out through the Navel, and, together with the Funiculus Umbilicalis, continues its Course to the Root of the Placenta, where it terminates and forms a particular kind of Bladder by its own Membrane, which is much thinner than, and very distinct from, the two Membranes of the Chorion and Amnios; this Membrane called the Allantois, and forming an oval Bladder, is situated betwixt the Placenta covered with its Chorion and Amnios, and betwixt the Chorion itself, which last is reflected over and grows to it; being designed for a Receptacle to the Urine of the Fœtus, which is more *abundant*⁶ in Quantity, higher coloured, and more nearly resembling the Urine of an Adult, as the Fœtus grows larger and approaches nearer to the Birth.

¹ They are even six Times larger in Proportion to the rest of the Body.

² The smaller the Fœtus, the more separate and distinct are the smaller Kidneys or Glands, of which collected together they are composed; and the more mature the Fœtus, the more even and compacted together are these distinct Portions into one Mass; yet *Eustachius*, by macerating the Kidney of an Adult, has distinguished it into twelve (*Corpora Pyramidalia*) pyramidal Bodies. But if the Kidneys thus appear larger and more lax in the Fœtus, they must, consequently, secrete a great Quantity of Liquor.

³ This Urine, in a healthy Fœtus, has neither Smell, nor any saline or bitter Taste; and, upon dropping some of it into the Eye, it does not give any Uneasiness. This Liquor is continually separated, since the Pelves of the Kidneys are always full, and the Papillæ continually moist.

⁴ Even the most healthy Person cannot discharge their Urine or intestinal Fæces without the Assistance of Inspiration; which therefore is required to discharge the Urine, unless the Solids are injured by some paralytic or other Disorder. But the Fœtus appears to make Urine in the fourth Month, and to continue that Secretion, slowly indeed, but constantly during the other five Months; nor does this Urine flow into the Amnios, since the Liquor contained in that Membrane is always less in Quantity, as the Fœtus advances nearer to the Birth; whereas the Urine is more abundant, as the Fœtus approaches nearer to its Exclusion; to which add, that the urinous Liquor of the Fœtus never hardens by Heat or Fire, as we observe in the Liquor of the Amnios.

⁵ The Urachus is a Production from the Fundus of the Bladder, from whence it passes on to the

the Navel, through the Funiculus Umbilicalis to the Middle of the Placenta, where, departing from the Vessels, it forms a third Membrane of the human Fœtus, as well as in Brutes, under the Denomination of Tunica Allantois, for the Reception of the Urine; which Membrane seems to have been by the Antients transmitted from Brutes only; but the celebrated Dr. *Hales* has described the same at large in a human Fœtus, in the *Philosophical Transactions*, N° 271. Into this Receptacle, therefore, the urinous Liquor of the Fœtus is collected, and seems to return to the Mother, having hardly the least Acrimony. By pressing the Bladder in a Fœtus, you will perceive the Urine pass through the Urachus into this Receptacle; and *Schenkius* confirms the same Passage by two Observations; the one of a Man who had his Navel cut off by Accident, from which Time his Urine always discharged itself through the Navel instead of the Urethra; the other of a Man, who, by some Disorder, being unable to empty the Bladder, had a Tumor formed round the Navel, which breaking, the Urine always discharged itself this way during the Remainder of his Life.

⁶ When the Liquor contained in this Membrane, the Allantois, discharges itself in the Birth, they usually call it the second or last Waters. For after the Chorion and Amnios are broke, their contained Liquor first escapes, and relaxes the Passages for the Exclusion of the Fœtus, which generally meets with an easy Birth, provided it follows immediately after the Discharge of this Liquor: But when the Fœtus comes some Hours after the Membranes have been broke, and their Waters excluded, then the Passages become dry, and render the Birth difficult; but in these Difficulties, the Midwife often meets with Assistance from

from another Water, which they call the second, coming from the Tunica Allantois.

§. 685. When, therefore, the intestinal Fæces and Urine being thus *accumulated*¹, without any Discharge, become uneasy to the Fœtus by their Bulk or Acrimony; then the *Vertex*² of the Head turns towards the Os Tincæ, its Face towards the Os Sacrum and Coccyx, while, in the mean Time, the Fibres of the distended Bladder and Intestines, being stimulated or put into Pain, excites the Fœtus to various Motions, by which its former Uneasiness is increased, and the Blood, thence circulating more swiftly, occasions the Fœtus to struggle every way, and more especially towards the lower Part of the *Uterus*³, whence follows a Tenesmus in the Mother; hence, likewise, the abdominal Muscles of the *Mother*⁴ begin to be violently contracted, and drive down the Fœtus into the Pelvis; whence again, the first Tenesmus is increased, and by the violent Endeavours of the Mother and Fœtus, the Os Uteri then relaxed and anointed with a lubricating Liniment is dilated, while the Waters of the Allantois and Amnios are protruded, their Membranes broke, and the Waters discharged, being followed by the Head of the Fœtus, thrust into the Capacity of the dilated Os Uteri, and the Mother's Throws then increasing, the Fœtus is at length excluded through the Passage of the Vagina, lubricated by mucilaginous and sebaceous Ducts,

Ducts, seated in its Sides; and then follow the Navel-string with the Placenta and Membranes, being partly thrust out under the Denomination of the Secundines, by the Contraction of the orbicular Muscle of the Uterus, and generally accompanied with more or less of an Hæmorrhage^s.

1. We know, that in Adults the Fæces are collected by Degrees in the large Intestines, without causing any Uneasiness; but in a natural State, or in a healthy Person, the Fæces are found thick and putrid in the Rectum, Colon, and Cæcum, but never in the Ilium. Now if so large a Quantity of the Fæces are collected in the Fœtus, that the larger Intestines, being full, refuse any farther Distension, then the Ilium itself will begin to be distended, and the Intestines will be no longer able to retain their Contents; for Gripes will then follow, from the Irritation of the very sensible Ilium, by the Fæces, which cannot be discharged without Respiration: 2. The Urine can hardly be deposited all together into the Membrane of the Allantois, while the Bladder is at the same Time full, and incapable of discharging any of its Contents by the Urethra; and from hence will arise another Stimulus. But such a conjunct Irritation of the Rectum and Bladder, we know, cannot be sustained by an Adult, without an inevitable Convulsion or Contraction of the Muscles; and therefore it must, consequently, produce great Uneasiness in the Fœtus. But there may, perhaps, be some other Causes assigned by the Creator for urging the Fœtus to seek for Air; and which Causes have not as yet been explained. The Blood itself seems to require more Air to attenuate it, whence the Circulation

culatation of the Blood becomes more impeded; and this may be a third Cause exciting the Fœtus toward the Birth. But we know from Experience, that the Fœtus included in the Waters, moves there like a Frog, by extending its Hands and Feet, which Motion is manifestly perceived, more especially in lean Women of a tender Habit. *Vesalius* made Experiments of this Nature at *Bononia*, *Padua*, and *Pisa*: He extracted, for Example, the gravid Uterus from some living Brute, as a Sow, and after laying the entire Uterus together, with a Fœtus upon a Table, he saw the Fœtus struggle and variously agitate itself in a Manner which no one would have expected from such small Animals. After cutting open the Uterus and Amnios, he always found that they breathed. Thus evident is the Fact, though the Causes thereof remain in Obscurity: For as *Cicero* says to *Milo*, concerning the Law of Self-preservation, we do not learn it, but have it infused into us by Nature.

² When there is but one Fœtus in the Uterus, and the Placenta adheres to the Fundus Uteri, as we generally observe it; in that Case the Fœtus sits with its Legs downward, its Heels drawn up to the Nates, the Knees up to the Mouth, the Spina Dorfi incurvated forward, with its Hands applied to its Mouth as if it would suck. Now this Posture of the Fœtus is easily supported by the Mother in the first Months of Gestation, the Forehead of the Fœtus being turned towards the Navel of the Mother, and its Knees to the Ossa Pubis; but the Head of the Fœtus growing much larger in Proportion to the rest of the Body, the Center of Gravity does not continue at the Navel, but is removed much higher. For in a new-born Infant, the Head is almost equal to one third Part
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of the whole Body, and in a Fœtus of the second Month, the Head is equal to Half, and the collapsed Lungs still adding to the superior Weight, causes the Fœtus, suspended freely in the Waters, to turn sooner or later, with its Head downward, whence the whole Fœtus becomes inverted with its Face towards the Os Sacrum, and the Vertex of the Head towards the Os Uteri. This turning of the Fœtus usually happens about six, seven, or eight Weeks before the Birth, but sometimes it happens only a Fortnight, or less, before the Birth, according as the Fœtus is proportioned, and of a stronger or weaker Make. But at this Time, also, the Abdomen of the Mother, which had been hitherto tense and most protuberant above, now subsides, and protuberates most at the Pubis; and, by perceiving this, Women know that the first Stage towards the Birth is over. By this means the Organs of Respiration in the Mother are set at Liberty, the Diaphragm being less compressed, now begins to act more powerfully, and to urge all the Viscera towards the Os Pubis, where is lodged the Head of the Fœtus; and, by kicking back with its Feet, the Vessels near the Os Uteri are differently pressed and urged, whence is discharged a Mucus more slippery than any other from the Cryptæ or Cells adjacent; which Mucus so abounds about the Os Tincæ and Vagina for many Days before the Birth, that its Approach is thus easily known, and the Passages well lubricated for the Exclusion of the Fœtus. But this makes the second Period; and, from the Discharge of Mucus, the Women themselves know that the Birth is not far distant. But the more spherical and distended the Uterus, the higher it always ascends from the Vagina, which in Virgins is hardly two Finger's Breadth distant; and, in the mean Time, it does not descend or increase
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downward. But the Birth approaching, the Uterus is now obliged to descend, because the Fœtus pushing with the Head downward, distends and flattens the Os Tincæ, which is then not round, but oblong, something like the Mouth; and this makes the third Stage before the Birth: But now the Lips of the Os Tincæ, being more distended and removed from each other, forms a considerable Opening; but in the mean Time the Fœtus being moved with a Tenesmus, as we said before, throws itself into various Motions, whence it thrusts the Uterus of the Mother more downward, its Head being lodged in the narrower Part of the Pelvis, so as to press upon the Bladder and Rectum. Hence, then, the Mother will be invaded with a Tenesmus, followed with Throws, or a painful Contraction of the abdominal Muscles from the Loins downward towards the Os Pubis. But this Action is accompanied not so much with a Pain, as an Uneasiness: For, upon frequent Enquiry, the Mother has always told me, that it was not a Pain, but a Tenesmus, or an Inclination to discharge the abdominal Contents. This Endeavour is insupportable, and something like that experienced by Men, when they endeavour to discharge their Fæces much indurated, and amass'd together into large Lumps, which sometimes has occasion'd such violent Strainings, especially in hypochondriacal People, as to force Blood out of the Nose, and sometimes even produce an Apoplexy by breaking a Vessel in the Brain. These Tenesmi or Throws always begin at the Loins, proceed from thence to the Navel, and from thence to the Os Pubis; the abdominal Muscles being so much indurated in their Contraction, that they feel almost like a Board: For where these Muscles arise, which are now most convulsed, there will be the Seat of the Pain.

Pain. This Mark of the Pains proceeding downward to the Navel and Os Pubis, with an Induration of the abdominal Muscles to the Touch, is the Sign by which the true Pains or Throws are distinguished from iliacal and hysterical Pains. But these Muscles arise from the Offa Pubis and Ilium, and the Head of the Fœtus in the mean Time continues to urge itself forward; whence the Uterus is thrust down into the Pelvis, which is the only way that the Fœtus can pass, since above, behind, and below, there are resisting Bones. In the mean Time the Convulsions increase in Proportion as the Uterus is thrust farther into the narrow Pelvis; and now it is that the Birth begins, when the Finger of the Midwife, being introduced through the Vagina, at the same Time perceives the Os Uteri relaxed and elongated like the Mouth, or an oblong Fissure. But now again the Throws increase, the Os Uteri dilates, and the Waters of the Amnios are thrust downward before the Head of the Fœtus, so that the Membrane may be touched like a Bladder containing Water. But when a pliable Membrane full of Water, and solid Bodies swimming in the Water, is urged or pressed on every Side, in that Case the Water will pass where there is the least Resistance opposed, but not the Bodies swimming in the Water; and therefore the whole Pressure determines the Birth towards the Mouth of the Uterus, which is thrust forward, and its Lips extenuated, which are Signs of an instant Delivery. In the mean Time the Membranes including the Water appear outward, and they thrust more forward towards the Os Uteri, the membranous Ball of Water increasing, and appearing more and more distended to the Touch; and this is what the Midwives call *the forming of the Waters*. In the next Place, the Head of the Fœ-

tus is thrust down to the Waters, which have already made their Passage, without as yet breaking their Membranes : The Pains in the mean Time increase, the Uterus is more pressed ; and thus the Waters of the Amnios equably distend and dilate the Os Uteri like a Bladder, so as to prove an excellent natural Machine or Instrument to forward the Birth, which the ignorant Midwives very injudiciously and rashly tear open, whereupon the Waters flow out, and the Membranes collapse ; but so long as the Membranes remain entire, the Os Uteri is equably distended by the uniform Pressure of a Fluid on all Sides without Pain, because the Os Uteri will be dilated uniformly without any violent Pressure ; but when the Membranes are broke open by the Fœtus itself, the Uterus is then pressed unequally. For every Solid presses more in one Part than in another, according to the Diversity of its Figure ; so that while one Part of the Uterus or Os Tincæ is without any Pressure, another Part will sustain the whole Force of the urging Fœtus. This bad Conduct has been the Cause of losing many Mothers and Infants ; namely, by breaking open the Membranes, and discharging the Waters, so soon as they perceive the Rima of the Os Uteri opening itself. But if neither the Midwife nor the Mother are too much in a Hurry, the Head of the Fœtus enters the Os Uteri, dilates the Pelvis, and then the Mother yielding stronger Throws than before, with a Sort of Convulsion, fetching a deep Inspiration, and retaining the Air a considerable Time, she then makes so strong an Effort, that the abdominal Muscles feel hard like a Board, and the Diaphragm itself, being thrust down from the Thorax, compresses the Abdomen, so that the Birth becomes, in a Manner, excluded with once straining. But these Efforts cannot be

made, if the Membranes are broke too early ; for then the Fœtus will be obliged to dilate the Os Uteri almost only by the Force of its own Body. But if, while the Fœtus and Secundines are making their way through the Os Uteri, the Membranes break and discharge the Waters, together with the Fœtus, the Birth will be well forwarded ; which it will not, when the Waters discharge themselves a long Time before the Birth, and leave the Fœtus to make its way through dry Passages, and to meet with Resistances of a Solid, which otherwise would have been easy and uniform by the Equability of the Pressure returned from the Parts to the Fœtus, and from the Fœtus again to the Parts by the Membranes, and their included Waters. The Birth proceeding in this Manner, with the Membranes entire, is the most natural ; for then the Amnios, Chorion, and Placenta, are excluded together. In this Manner it is probable that *Eve* was deliver'd ; and the same is customary not only to Brutes, but to whole Nations of the *Indians*, who are commonly deliver'd naturally, without any Assistance of Midwives. Nor can the Assistance of Art be of any Service, when the Fœtus is thus excluded with the Membranes entire. Next to this most natural kind of Birth comes that most common, but not yet perfectly natural Delivery, in which the two Membranes are broke, and the Waters discharged during the ultimate Throws or Efforts of the Mother, the Membranes themselves in the Placenta remaining afterwards in the Uterus. In this last kind of Birth, the Fœtus ought to be turned and involved, that it may breathe, and that the Mother may, in the mean Time, be freed from her Burden, by extracting the Placenta and two Membranes ; after which the Navel-string is to be cut off at a proper

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Distance,

Distance, but not before the Placenta has been extracted, so as to make the Life of the Fœtus independent of that of the Mother. Here Art will have no Share in the Delivery; and, in general, those Births are the most happy which have none of its Assistance, as those clandestine ones of deceived Virgins generally are. I remember a Girl thus taken with Pains at a Feast, which the People called hysterical; but, departing into the next Chamber, she excluded the whole Birth or Ovum with the Secundines entire. But when we endeavour to assist by Art, Nature is frequently disturbed, though it is herself generally which performs the whole Work. But if the Birth is preternatural, then it will be necessary to use the Assistances of Art, to reduce the Parts to their natural Order, and remove the Obstacle. For when the Placenta is not as yet mature, it then usually adheres too firmly to the Uterus, like an unripe Fruit, which easily falls off when perfectly ripe. When therefore the Placenta adheres so firmly to the Uterus, that it cannot be excluded by the Throws of the Mother, the Fœtus being at the same Time out of the Uterus, and breathing in the open Air; in that Case, the Midwife takes hold of the Funiculus or Chord in one Hand, and follows the Course of it with the other Hand to the Os Uteri, which is then very open, and does not very suddenly contract itself, till she arrives at the Membranes, betwixt which and the Uterus she insinuates a Finger towards the Sides of the round Placenta, enquiring for the Place of its Adhesion, where, bending her Finger into an Arch, she sustains and presses back the Uterus, at the same Time gently drawing down the umbilical Chord, which is the greatest Artifice in this Affair; and if the Placenta yields but a little way, it will easily follow.

follow. But if the Midwife inserts her Finger betwixt the broken Membranes, from whence the Foetus was excluded, namely, the Chorion and Amnios ; then the Placenta will be lacerated, and hardly separated from the Uterus without Inflammation. We may illustrate this by the Instance of Children, who endeavour to raise Stones out of the Street by a Sucker, or round Piece of Leather, with a String fastened to its Middle : If now the Leather is pressed close to the Surface of the Stone, by pulling at the String, the Leather firmly adheres and raises the Stone ; but if one Part of the Leather is unequally or less closely pressed against the Stone, it then slips off as the Placenta ought to depart from the Surface of the Uterus. If the Midwife only pulls the umbilical Chord without supporting the Uterus at the same Time with her Fingers, if the Placenta then adheres very firmly, she may draw down and invert the whole Uterus ; which if left in that Manner inverted, the Mother will be lost in the Space of three Hours ; nor can she be preserved, unless the Uterus is replaced immediately after its Inversion : For, in this Condition, the Uterus filled with stagnant Blood, and brought into Contact with the external Air, becomes inflamed, and is often invaded with a Gangrene or Mortification even after it is returned. But even when the Finger is introduced into the Uterus, the Midwife ought to manage it with Discretion, to avoid injuring this Part with her Nails, which may excite an Inflammation, and its Consequences, seldom curable when seated in the Uterus.

³ The Uterus of a Woman, neither with Child, nor in her Menses, is in the Shape of a Pear or Top, the Figure of its Cavity being that of an obtuse Cone. In this Case the Uterus is not far

distant from the Vagina; but when a Woman has conceived, the Uterus always ascends, and removes itself at a Distance from the external Opening of the Pudenda; and this is one of the first Signs of Conception. The Cause which changes the Figure of the Uterus is the Ovum contained in its Cavity, and distending its Sides into a spherical Figure; for we know that every Membrane, being equally distended on all Sides by any Fluid, becomes spherical. The Uterus itself, having thus changed its Figure, does likewise receive a Change in the Figure of its Os Tincæ, which becomes more elliptic and flat, so that it may lie upon the Surface of the Sphere, without protruding forward into the Vagina. But the more the Uterus is increased in Bulk, the higher does it ascend out of the Pelvis, because that Cavity becomes less than the Sphere of the gravid Uterus, which, finding no Room in the Pelvis, is obliged to ascend into the Abdomen, even sometimes above the Navel.

⁴ It was observed before, that there are three Causes of the Birth which regard the Fœtus, and as many which regard the Mother. First, A Deficiency of Aliment; for the larger the Fœtus, the more Aliment it requires. 2. An increased Pressure upon the Parts of the Mother below, whence more Blood is sent to the superior Parts; and from thence follows, 3. An Irritation of the Nerves.

⁵ The Moment after the Placenta is separated, the Blood follows not in Drops, but in a full Stream, unless the Mother was almost exhausted before. But no Blood issues forth before the Separation of the Placenta, unless the Birth be preternatural, or some Part lacerated; but the Waters and Mucus always come before the Placenta, which itself being separated from the Uterus, is then followed with a Flux of pure Blood. The

Uterus

Uterus of a Woman in the ninth Month of her Pregnancy, is at least twenty Times larger than it was in the first Month; which Difference proceeds entirely from the great Quantity of Blood which stagnates in the spongy Body and Cells of the Uterus, next to the Placenta; which is denied by no one, since we do not here ask whether it enters the Placenta. If now the Placenta is removed, these Vessels are then opened, and the Blood which communicated itself from the Vessels of the Uterus to those of the Placenta, does not return into the Veins, nor could it so return without Detriment to the Mother, and is therefore discharged into the Cavity of the Uterus; since the Placenta which stopped up the Mouths of so many Arteries is now removed, whereupon all that Blood issues forth, which had been hitherto retained in a great Quantity in the Uterus. This Hæmorrhage therefore does not disturb or alarm the skilful Midwife, unless it should be too profuse. But when an Hæmorrhage comes from the Uterus of a Woman with Child before the Time of her Delivery, it is then always to be feared, and will be of fatal Consequence to the Mother, if the Fœtus is not immediately extracted, that the Vessels of the distended Uterus may collapse; for so long as the Fœtus keeps that Part distended, the Mouths of the divided Vessels always continue open, pouring out the Blood till the Mother expires. Hence it follows, that no Blood ought to flow from the Uterus, before the Exclusion of the Secundines: But when a red coloured Water is discharged either before the Birth, or when the second Waters have been evacuated, the Fœtus has then breathed, and is in the utmost Danger of being lost.

§. 686. But when all these are *excluded* ¹ from the Uterus, its strong Fibres, more especially those seated contiguous to the Placenta, with the Fibres and Vessels of the Peritonæum and abdominal Muscles, after being greatly distended during the latter Stages of Gestation, now begin to *contract* ² themselves; and the Vessels of the Uterus, more especially, contracting themselves slowly and gradually, it *evacuates* ³ the Blood, which had been hitherto collected in its Cavity; from whence it flows at first pure and in a great Quantity, but afterwards more sparingly and dilute, till at *length* ⁴ becoming pale, viscid, and little in Quantity, it passes under the Denomination of Lochia; which last Flux *varies* ⁵ in Quantity, Continuance, Colour, Smell, and Consistence, according to the different Constitution, and as the Mother either suckles the Child, or not.

¹ The Mother suffers extreme Pains, both before and in the Birth, more especially at the Time when the Head and Shoulders of the Fœtus come forth; but when the Fœtus and Placenta are excluded, the most desired State of Tranquillity follows, with which, according to the Acknowledgment of the Mother, no other Happiness in Life can be compared. But this is, in Reality, a dangerous Tranquillity, for the Mother never expires in the natural Birth till after she is delivered; whereupon all the Blood flows to the Abdomen, deserting the Brain and Cerebellum. To prevent this, therefore, a Belt ought to be applied about the Abdomen after the Delivery, agreeable to the Custom
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in *England*, that the *Abdomen* may be thereby compressed, and the *Blood* prevented from flowing too plentifully downward so soon as the *Mother* is delivered. Thus the *Mother* is preserved from *Convulsions*, *Faintings*, an *Apoplexy*, &c. and, in the mean *Time*, Care must be also taken to prevent the cold *Air* from coming into *Contact* with the *Uterus*.

^a After the *Fœtus* and *Secundines* are extracted, and the *Blood* collected during the whole *Time* of *Gestation* is discharged from the uterine *Vessels*, its *Body* then contracts itself, and recovers its former small *Dimensions*; and there being now no *Causes* to distend the *Uterus*, its *Vessels* are therefore now compressed every *Moment*, and their *Orifices* closed more and more by *Degrees*. At first therefore that *Blood* is forcibly evacuated, which resided in the uterine *Arteries*, to be gradually transfused through the *Placenta* for the *Nutrition* of the *Fœtus*, without returning again thro' the uterine *Veins* of the *Mother*. This *Blood* residing throughout the whole *Substance* of the *Uterus*, does therefore powerfully discharge itself when the *Vessels* are open, or wounded by a *Separation* of the *Placenta*. But after sincere *Blood* has continued thus to flow from the *Uterus* for several *Days* (three, four, or five, more or less, according to particular *Circumstances*, but seldom above a *Week*), then the *Lochia* begin and flow slowly, as being discharged from the open *Vessels*, which, by *Degrees*, more and more contract themselves.

² The *Uterus* is thus cleansed from that *Portion* of the *Blood* which stagnated in its distended *Vessels*, which, if retained, might have occasioned many *Disorders*: For, not being capable of returning through the *Veins*, but stagnating, it might pro-

duce an Inflammation of the Uterus, a Delirium, violent Fever, and even Death itself. Great Care ought therefore to be always taken to prevent a Retention of the Lochia, which may be stopped by Cold, the rough Treatment of the Midwife, or leaving Part of the Membranes behind.

⁴ At length the uterine Vessels contract themselves so far, that they are no longer capable of transmitting the red Blood, but only the serous and mucous Parts of it, tinged a little red, till at length only its natural mucous Liquor is discharged in an increased Quantity, and, becoming gradually drier, the Os Tincæ is at last closed. But as yet the Bulk of the Uterus exceeds that which it had in a State of Virginity, which it does not acquire under the Space of seven, eight, or nine Weeks Time, when it again becomes fit for Impregnation, and is capable of retaining the Fœtus, which it is not before, except in some very strong Women.

⁵ According to the different Habit or Constitution of the Woman, and Quantity of the menstrual Discharge: For some Women, who have been subject to a copious Discharge of the Menses, have their lochial Flux continue upon them above a Month; whereas in others, again, there is hardly any other Discharge besides the first Hæmorrhage; namely, in such as have been before accustomed to a small menstrual Flux.

§. 687. When the Parts are thus *contracted* ¹ (§. 686.), the diminished Vessels more powerfully resist the Blood about to deposit itself into these Parts; and about the third Day after the Birth, the hypogastric Arteries *communicating* ² with those of the Breasts, which are still dilated, pour more Blood and watery Chyle

Chyle into them, which before used to be conveyed to the Uterus: Hence the Breasts will be more filled and distended, by the translated Humours thus filling their Vessels; whence a slight Fever, Tumor, Pain, and Hardness of the Breasts, with a Formation of the Milk, follow.

¹ The Vessels of the Uterus are now less capacious, and afford a greater Resistance to the Blood and Chyle about to deposit themselves into this Part; and therefore both these Humours, which before used to stagnate in the uterine Arteries and Cells without returning through the Veins, being now refused Admittance are retained in the Habit, returned from the Uterus to the Vena Cava, Heart, and pulmonary Vessels; thence continuing its Course in the Circulation by the Aorta. Hence arises commonly a slight Fever, which is usually denominated Lacteal, being customary to Women in Child-bed, and lasting but a few Hours; during which Time the Breasts begin to swell with Heat and Pain, and the lochial Discharge lessens. If now the Breasts are sucked by the Infant, or pressed by the Mother, they become, instead of the Uterus, a Receptacle to the redundant Blood and Chyle, which before used to be consumed by the menstrual Discharge, and was afterwards employed in nourishing the Foetus, the same Humours are now conveyed to the Breasts, whose Vessels are opened by Suction; and if the Breasts continue to be sucked, either by the Infant, or a grown Person, in a few Days Time the lochial Discharge will cease, except only a few Drops of a purulent Consistence made from the secreted and stagnating Humours.

Formerly

² Formerly *Galen*, and latterly *Riolen* and *Nucke*, take Notice of the Vessels communicating from the Uterus to the Breasts, by which the Humours are transmitted to the latter: Namely, the mamillary Artery arising from the Arch of the axillary Artery is reflected under the Clavicle to the Ribs, from whence it descends to the Middle of the Breasts, where it is distributed. 2. From the Trunk of the hypogastric Artery, which likewise sends Arteries to the Uterus, ascends an Artery in a contrary Direction to the Breasts, which perforates the abdominal Muscles; thus the mamillary and epigastric Arteries meet each other in contrary Directions. So that the Creator would not have the Blood pass in a direct Course to the Breasts, any more than to the Uterus; but that Blood which is the least fit for Motion, or the most replete with Chyle, is sent to the Uterus by the retrograde Arteries before mentioned; and therefore, by the same Arteries, the same Humours will be conveyed to the Breasts, which used to be before conveyed into (but are now refused Admittance by) the uterine Vessels.

§. 688. For the Breasts being seated at Liberty from Compressure, covered only with the Fat and Skin, which are easily *dilatable*¹, receive their external Arteries from the Axillaries, and their internal Arteries from the Subclavians, from whence the latter descend along the Thorax, and pass out through the Interstices betwixt the Ribs and Sternum to their Distribution in the Breasts, where *communicating*² with the epigastric Arteries, they are surprisngly contorted and wound up in Spires and Bundles; from

from whence, at last, they send out small lactiferous Tubes in a *direct*³ Course, which, uniting into larger, compose the ample lactiferous Ducts, terminating from a larger into a smaller Capacity, till they open with a very small Orifice in the Nipple; but in such a Manner, that there is a free Course or Passage from the Arteries through the lactiferous Tubes to the Nipple, and from the Nipple by the same Tubes to the Arteries again: But these Nipples or *spongy*⁴ nervous Papillæ have *several*⁵ Emissaries, varying in Number, and communicating with each other by Anastomoses before they terminate externally; they are also encompassed with a *Circle*⁶ beset with sebaceous Lacunæ, and sometimes lactiferous Ducts, and they are also replenished with many nervous Papillæ: So that from hence, by sucking, the Milk is drawn out and continually *renewed*⁷ for the Nourishment of the Fœtus, abounding more in Proportion as the Breasts are more sucked.

¹ The Breasts are entirely at Liberty, without being subject to Compressure. They are seated upon the large pectoral Muscles, with some Fat interposed betwixt them; so that being on all Sides free, except where the Nipple adheres to the thin Skin, therefore the Breasts very easily admit of Distension, and may be easily extirpated by the Surgeon, without injuring the pectoral Muscle.

² This Communication is the Reason, why the Blood is derived to the Breasts by so many turning and winding Vessels: For the Design of Nature
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here, was to procure a free Communication from any one Vessel to all the rest.

³ In such a Manner, that the Extremities of the sanguiferous Arteries are extended into lactiferous Tubes, without the Interposition of Glands, and the red Blood flowing from the sanguiferous Artery into the corresponding sanguiferous Vein, the lacteal Juice is, in the mean Time, carried off from the Artery by the lateral Duct towards the Nipple. For when the Arteries of the Breasts are injected, the Liquor passes into the lactiferous Ducts; and when, on the other Hand, the Liquor is injected by the lactiferous Ducts, it fills the sanguiferous Arteries and Veins; so that while the Milk continues fluid, it may return back into the Blood. Several of these lactiferous Ducts are demonstrated by *Nucke* to meet together into one Duct, which is larger towards its Root, but becomes contracted towards its Extremity at the Nipple. These lactiferous Ducts or Vessels being filled with the Chyle, attenuated by circulating with the Blood, cause a Distension or Tumor of the Breasts, without receiving any more Blood; for there is no more Blood in the Breast of a lying-in Woman than at any other Time of Life.

⁴ The Nipples have a spongy Substance, almost like that of the Male Penis, by which the Nipples are enabled to become stiff and turgid by Attrition.

⁵ To the Number of ten or twelve, terminating not in the Middle, but in the Circumference of the Nipple. Through these Ducts a large Quantity of Milk flows, after they have been once opened by the sucking Infant; nor does the Milk flow out spontaneously in a healthy Woman, though the Breasts be ever so much filled, without the Assistance of Suction or Pressure. But if two or three Children continue sucking at the Breasts, they

they may draw out not only all the Mother's Chyle, but, at length, even Blood itself may follow; but the Blood, being brackish and ill-tasted, is refused by the Infant, which therefore will suck no longer.

⁶ In this Circle are seated Cryptæ, or Cells, containing an oily sebaceous Matter, serving to lubricate and defend the Papillæ from Attrition by the Infant.

⁷ I saw a Case in which thick Ale drank by a fasting Nurse, was, in the Space of five Minutes Time, discharged through the Breasts; that Liquor having, in so short a Time, compleated its Course with the Mass of Blood. For so soon as the lactiferous Ducts are emptied, they are filled by the succeeding Humours, while, at the same Time, they are relaxed and dilated by sucking. When a Woman suckles one or two strong Infants, and applies them hungry to her Breasts a considerable Time after a Meal, the Breasts soon after appear flaccid and collapsed, almost like an empty Bag; but if then the Nurse drinks plentifully of sweet Oat-ale or Milk, the Breasts will be again filled in a little Time, as if they were made of a Sponge dipped in Water or Milk. I saw a Woman who had a constant Discharge of Milk from her Breasts for the Space of two whole Years, without Intermission; for whenever she drank, all the Liquor returned through her Breasts; and without drinking, she would faint away: But, by proper Means, I restored this Woman to her Health, after she had in this Manner languished for the Space of two whole Years.

§. 689. *This Milk* ² easily separates into *Whey* ³, Cheese or Curd, Cream and Butter; the cheesey Part growing wonderfully hard:
Yet

yet the Milk does not congeal or harden with Heat like the Serum of the Blood, but the watery Parts *exhale*⁴, and leave the Craffamentum or Curd-like Part behind; and tho' it is apt to turn sour *spontaneously*⁵, yet it is naturally sweet, white, and almost without *Smell*⁶, being formed from the *Chyle*⁷ and oily sweet Juices of the Mother mixed together by the Circulation.

¹ The first Milk which is discharged from the Breasts after the Birth, is of a different Colour and Taste from that which follows some Time after, and possessing a purgative Quality, it helps to discharge the Meconium of the Infant; but the Children of great People being destitute of this Privilege of sucking the first Milk, they being conveyed as soon as they are born to suck the Milk of a Nurse who has suckled for some Time; they are, upon this Account, subject to a Retention of the Meconium, from whence arise a Multitude of Disorders.

² Milk is one of the whitest and sweetest Humours in the Body, from whatever Aliments it may be formed. It contains always a Portion of Oil diluted with Water, as is evident from the Quantity of Cream which is thrown up, from whence, by churning, is formed Butter. Milk is therefore evidently formed of the serous and oily Parts of the Chyle; though I cannot indeed deny, but that some Portion of the Spirits may be also conveyed to perfect the Milk, which may perhaps contribute something towards that Sweetness, which is more remarkable in Milk than in any other of our Humours. The Milk is thicker than the Urine, but thinner than the Blood and its Serum;

Serum; whence it is that the Milk never escapes through the urinary Passages in a healthy State; which is certainly a necessary Consequence of some latent Fabric in the Parts, and not altogether the Result of the particular Magnitude of the Vessels.

³ When any Thing acid is poured into, or mixed with, scalding Milk, it congeals into one uniform, scissile Mass, capable of being taken out of one Vessel, and put into another, without spilling a Drop; but after the same has stood for some Time, it separates into two Parts; the one called its Serum or Whey, and the other the Curd, which, by pressing out the serous Parts, becomes dry, and forms Cheese almost as hard as a Stone, more especially if the Cream was first taken off; but if the Cream was left in the Milk before it was turned, the Cheese does not then become so hard. But the Serum or Whey left after the making of Cheese, contains abundance of nutritious Parts sufficient to nourish any strong Man; and I have myself experienced that one may live very well upon Whey only. What has been said of Cow's Milk, holds true also in the Milk of Women.

⁴ It is not therefore with Discretion that Women boil the Milk intended for Children for an Hour or two over the Fire, in order to remove its imaginary Crudity; whereas the Milk is vitiated by losing its more fluid and salutary Parts; and it would be much more wholesome to give the Milk warm from the Cow, or at least without boiling, only with the Crumb of Bread to young Children.

⁵ It turns sour, of its own Accord, in the Space of six Hours, when the Air is very hot in the Summer-time.

⁶ If you are about to examine into the Nature of Milk, or to answer for its Goodness, you ought always to regard the Smell of it.

Not

⁷ Not the Chyle as it is in the Stomach, of an ash Colour, and too much inclined to Acidity; nor yet the Chyle of the Duodenum, of a yellow Colour, and bitterish Taste; nor yet the white and sweet Chyle of the small Intestines; nor of the lacteal Vessels mixed with the thinner Lymph, and conveyed crude into the Blood: But it is a Part of that Chyle which has passed through the Lungs, and been intimately combined with the Lymph; nor is there any other Way by which the Chyle can pass into the lactiferous Ducts, but by being first attenuated in passing one or more Times through the Lungs with the circulating Blood: To which add, that the Chyle receives something towards its Formation into Milk from the Mother's Blood.

§. 690. From what has been said, the Reason is evident why a Pain, Hardness, and Tension, of the Breasts, with an Elevation of the Nipples, and a transuding of Serum, sometimes happens towards the Evening in Women who are *with Child*¹; and why all these increase more especially for three Days before the *Birth*²?

Whence it is that drying up of the Milk *increases*³ the lochial Discharge, and the Reverse?

Why the Colour, Smell, Taste, and Qualities, of the Aliments or Medicines shew themselves remarkably in the Mother's Milk?

Why the *Milk*⁴ hardly discharges itself *spontaneously*⁵, but often *starts out*⁶ when the Passages have been first cleared or opened by sucking?

Why

Why Milk is sometimes found in the Breasts of *Men* ⁷ and *Virgins* ⁸, and always in the *Fœtus* ⁹ of both Sexes?

Why of all the Humours in Animals Milk *only* ¹⁰ has, for the most part, a natural Inclination to turn *sour* ¹¹?

Why the Milk so readily separates its *Cream* ¹² and Curds or cheefy Part?

Why the Milk differs much at different *Times* ¹³ after a Meal? Hence it appears that immediately after Aliments taken by a Person fasting, the Milk retains and *communicates* ¹⁴ the good or bad Qualities of the Aliments, and appears *best* ¹⁵ four or five Hours after the Meal; whereas in about twenty-four Hours after, in a Nurse that is fasting, the Milk is found salt, unpleasant, yellowish, soon contracts an ill Smell, and is *disagreeable* ¹⁶ to the Infant?

Hence it also appears upon what Principle is founded the ordering of a particular *Diet* ¹⁷ or Regimen to a Nurse for the Health or *Good* ¹⁸ of an Infant.

¹ Women are generally impregnated towards the End of their menstrual Flux, as appears from numerous Instances in *France*; for out of an Hundred Births, Ninety-nine happen in the ninth Month from the End of Menstruation, reckoning from thence forward nine Months of Gestation. For at the Time before mentioned the Uterus is empty and cleansed, while the Plethora is removed at the same Time; nor is there so much Danger of an Expulsion of the Ovum. But the Woman having thus conceived, her returning Plethora, after the Space of three Weeks, will not be capable of de-
P
positing

positing itself through the uterine Vessels ; and the Foetus, at the same Time, being very small during the first Month, therefore the Blood will regurgitate into those Vessels which communicate with the Uterus, whence the Breasts will be distended ; and from this Sign the Woman knows herself to be with Child even before the Menfes appear to be suppressed ; that is to say, the Breasts swell about the Time when the first menstrual Discharge is expected, but retained.

² For then the Plethora, which used to be carried to the Uterus, a Part now contracted, flows back to the Breasts ; and so soon as the Quantity of the lochial Discharge lessens, the Breasts become turgid.

³ Most Women of Quality imagine they shall preserve their beautiful Shape by not suckling their own Children. But we ought not to presume ourselves wiser than Nature, who never changes her Laws with respect to the Fabric of the human Body. Now these Women in the third Month of their Gestation, and again at the Birth, have their Breasts distended ; but they repel that Milk with Medicines which ought to have supplied the Infant, which, if attended with the best Success, always occasions an Increase of the lochial Discharge and of the Menfes returning every Month ; whereas those who suckle their own Children have a less Discharge of the Lochia, and have all the Symptoms of their lying in milder without any Return of their Menfes so long as they suckle.

⁴ The whole Body, with all the Arteries and Veins in a Woman, especially the Vessels of the Uterus and Breasts, are so lax, that the whole Mass of Blood and Humours is less apt to circulate through the Body, whence they will be continually deposited either at the Uterus, or Breasts ; but
more

more at the latter, where the Resistance is taken off by sucking, which operates in the same Manner with the Air-Pump: For so great is the Effect of sucking, that, without this, the Breasts would remain dry. This is therefore the Cause why the Chyle, not yet accustomed to pervade the smaller Vessels of the human Body, does nevertheless easily escape into the Breasts.

⁵ This seldom happens, for the Reason last mentioned, and from the cavernous Substance of the Nipples being collapsed, so as to compress the lactiferous Ducts; but when the Infant sucks, the Pressure of the external Air is removed from the Nipple, by which means the cavernous Substance expands, and the Humours flow plentifully into the Vessels to fill the Cells, while, at the same Time, the lactiferous Ducts are opened, and the Milk easily passes through them by sucking.

⁶ Sometimes the Milk starts out to the Distance of two or three Feet. The Reason is, that the Nipples, left to themselves, hardly give any Passage to the Milk; their spongy Fabric collapsing and compressing the Mouths of the lactiferous Vessels: But when the Nipples are tumified and erected, by the Titillation of sucking, then their spongy Fabric ceases to compress the lactiferous Ducts, which being now at Liberty, the distending Milk starts forth through them.

⁷ *Schenkius* gives us several wonderful Instances of Men who have had Milk in their Breasts; and there are other Instances to be met with, in the Writers upon the Diseases of Women. Nor ought this to seem wonderful to us; since the Blood-Vessels of Men, as well as of Women, are replenished with Chyle, which, attenuated, becomes Milk; so that we are all of us nourished by Milk only: For whatever kind of Food we eat, the

Chyle made from thence forms itself into Milk before it becomes fit for Nourishment; and that Milk, by repeated Circulations, diffolves into Serum (§. 138.). But, besides this, Men have also Breasts, Nipples, and Areolæ, seated in the same Part, and of the same Fabric with those of Women; only they are less lax with Men, and less turgid with Humours: If, then, the Vessels in the Breasts of the Male are dilated, Milk will certainly be formed in them. There was a poor Man, who, having lost his beloved Wife, who left a young Infant crying Day and Night, the Father, to quiet it, applied his own Breast: Whereupon, the Infant sucked violently, so as to bring Milk; and the Man himself became the Nurse.

* The Reason is the same, also, with respect to the Appearance of Milk, sometimes, in the Breasts of Virgins. We had an Instance of this here at *Leyden* in an honest Maiden, who had never conceived, nor had a Child; but, lying with her Mistress's Children, and being tired in the Night-time with their crying, she put the Child to her Breasts, which, by repeated sucking, at last drew forth Milk. Upon the Discovery of this, her Chastity was suspected, and she supposed to have lately lain-in, till her Honour was cleared, by a strict Enquiry, by the Midwives, who could easily have discovered the Signs of her lying-in.

9 Every new-born Infant, that I have yet seen, whether Male or Female, has its Breasts turgid with Milk, with the Nipples tense and erect, so that the Nurses usually empty them by sucking or pressing out the Milk, to prevent the stagnating Liquor from causing Disorders; and then the Humour discharged appears exactly like that which comes from the Breasts of the Mother the Day after the Delivery. The Day after a Cow has brought

brought forth her Calf, she gives a very sweet and thick Milk, called Beastings, very different from the common Sort of Milk, thickening, over the Fire, like a Custard. Of this Sort of Milk is that contained in the Breasts of the Fœtus, which being sucked out, returns again, till, after a few Days, it is dried up, and disappears; as in Women after weaning their Children. But from whence happens this, and to what Purpose does it serve? The Cause seems to be manifest, though not hitherto explained. The Breasts of the Fœtus, soon after the Birth, appear pellucid and turgid with Milk, which, if not discharged, produces wonderful Disorders. But we know, that all the Glands in the Fœtus are much larger and more distended in Proportion than in the Adult. The Thymus in the Fœtus is not much less than one Half of the Lungs, and has a considerable Opening into the Oesophagus, according to the Accounts given me by a considerable Anatomist: But this Gland by Degrees lessens, so that in the Adult it contracts almost to nothing. In the same Manner the Breasts are large in new-born Infants of both Sexes, but from thence, to the Age of Puberty, they decrease; for, till then, the Breasts of a Girl are no larger than those of a Boy. But the Use of this Milk in the Breasts of a Fœtus is something more obscure. Some have imagined, that the Infant sucks itself in the Womb, because it lies there in a bending Posture with its Head inclined forward. When I consulted *Ruyfch* upon this Subject, he wrote me Word, that he sometimes found Milk in the Breasts of the Fœtus; but that it still remained to him a Matter of Enquiry, whether it sucked its own Breasts, if he should meet with an Opportunity of observing a living Fœtus in the dead Mother? But from that Time he has had no such Opportunity, and is

now taken from us by Death, *Ann.* 1732. Whether or no the Breasts separate that Liquor, which we find in the Cavity of the Amnios? At least there seems to be something in this Matter unknown to us.

¹⁰ For Milk is nearly related to Chyle, not having, as yet, acquired a Disposition to turn alkaline, which is a Quality peculiar to all the rest of our Humours.

¹¹ It turns sour, because it either is the Chyle itself attenuated, or else a crude alimentary Humour next to the Chyle.

¹² The Formation of this Cream may appear from the Preparation of an Emulsion. When Almonds, Barley, Rice, or the common cold Seeds, both the greater and the less, are ground with Water, the Oil mixes itself therewith, and forms a perfect Chyle: But when this artificial Milk has stood some Time, in a Quarter of an Hour a Cream will arise to the Surface, the serous Parts remaining below; almost in the same Manner the oily Parts of our Food, being ground together with the Lymph and watery Liquors, form Chyle. But in an Emulsion there is no Crassamentum or Curd, which does not indeed seem to be formed in the Chyle before it has been converted into Milk. Hence poor Milk always produces bad Cheese; whereas the very best Cheese is made from that Milk which has been well digested, by circulating a long Time with the Blood of the Cow. This Cheese, being distilled, yields the same Principles with Hartshorn, or human Blood; and even barely by exposing this Cheese to the open Air, it will, in process of Time, putrefy, so that by its Acrimony it becomes caustic, and corrodes the Skin, if applied; of which Nature is a great deal of the Cheese made in the northern Parts of *Holland*.

¹³ It is commonly supposed, and even by many Physicians, that Milk is always one and the same kind of Liquor, endowed with the same Qualities; whereas, like the Urine, the Milk differs almost every Hour after a Meal, as I have been well assured, from Experiments. If a Woman has suckled a thirsty Infant for a whole Night without drinking any Thing all that Time, her Breasts will be quite flaccid, and her Thirst very intense; inso-much, that a Nurse owns she can have no greater Pleasure than from Drink at that Time; but if she drinks nothing, and yet applies the Infant to her Breasts in the Morning, it will certainly refuse the unpleasant Milk. If now the Nurse drinks, her flaccid Breasts will become turgid, and the Infant will greedily suck out the Milk, which did not reside in the Blood with those Qualities which it appears to have when drawn out by the Infant; but is derived from the Drink diluted and changed by circulating one or more Times with the Blood, from whence it is derived into the Breasts, not crude, but in part prepared by the Circulation.

¹⁴ If the Nurse commits any Error in her Diet, the Infant will, of Necessity, do Penance: If she took a Purge, the Infant will be purged; if she drank Wine or spirituous Liquors, it will be intoxicated. But this happens, more especially, when the Breasts are flaccid and empty, rather than from what she eats or drinks, while the Breasts are distended with Milk already formed: For if the Breasts are thus full, the Nurse may drink Wine, &c. and yet, though the Infant be constantly held to the Breasts, it will not draw forth the new Chyle, but the Milk already formed. But when the Infant sucks while the Breasts are flaccid, the Nurse having lately drank plentifully of spirituous or fermented Liquors, the thirsty Infant then greedily

draws forth the poisonous Liquor. I visited a noble Infant afflicted with Convulsions, but the Nurse appeared healthy, and I could discover no Cause for such a Disorder in the young Infant: But I observing the Nurse stand by the Infant with a brisk and somewhat of a fuddling Countenance, I asked her whether she loved Drink, and she said yes. I again asked at what Time she last gave the Infant suck, and she answered after Dinner. I asked again whether the Child was before well, and she said yes: Therefore considering the Ructus and Convulsions of the Infant, with the Confession of the Nurse, I plainly perceived that the Infant was drunk; which at that tender Age of Life is enough to destroy an Infant: And it was with much Difficulty that I could preserve the Child by all the Assistances of Art. I am fully persuaded, that Infants are oftener killed than one would imagine, by the drinking of Wines and other strong Liquors, frequent among the Nurses belonging to People of Quality and Fortune; and to this Cause is frequently owing the morbid and weak Constitutions of the Children of great People. A fatal Case, of this Nature, happened in a certain Court: The Physician ordered a purgative Medicine to the Nurse of a Prince, but by Negligence had forgot to inform her, that she ought not to let the Prince suck before the eighth Hour after she had taken the Purge; so that, being ignorant of this Caution, she gave her Breast to the unfortunate Child, which very greedily sucked out the whole Force of the Purge from the Nurse, and soon after expired with an over-purging. Had the Physician given the Nurse this Caution, he would have been quite free from Blame. On the other Hand, by the Error of the Physician, Lettuce, Wine, Ale, and other Acids, are often prohibited from the Nurse, which yet
are

are extremely wholesome to Nurfes, provided they are admonished not to apply the Infant to their Breasts when they are flaccid, soon after eating such crude Aliments; for in the Space of eight Hours after taking such Food, the Milk which they afford is not at all vitiated. But when the Nurse has been quite exhausted, and then drinks profusely of strong Beer, her Breasts will indeed be soon filled with Milk, and she will even perceive the Pressure of new Chyle returning towards her Breasts: But if then the Infant is imprudently applied to the Breasts, it will soon be inebriated and afflicted with various Convulsions. Thus do unfortunate Children frequently perish through the Errors of their drunken Nurfes: For by immediately applying the Infant to the Breasts, the Ale and other crude alimentary Juices are drawn forth, little or nothing altered, from the Breasts, which have been before exhausted of their Milk.

¹⁵ Milk is best some Hours after a Meal, by which Time it has deposited its Crudity by passing many Times thro' the Lungs with the Blood; so that it is best to apply an Infant to the Breast about four Hours after a Meal.

¹⁶ If a Nurse has fasted twenty-four Hours without eating or drinking, as was formerly enjoined by some religious Sects, and as sometimes happens among us when the Woman nauseates Food upon the Account of some Fever, her Milk will then not be potable to any Infant. If a Woman breakfasts at Eight in the Morning, and suckles her Child at Ten before Noon, if from that Time she fasts fifteen Hours longer, the Infant will refuse the Breast, and will continue its Cries, even though put into its Mouth; for the stale Milk which is then taken from the Breast, appears thin, yellowish, and salt, being by the *Dutch* called Brack, from the brackish Taste

Taste of Sea Water. It is not difficult to account for these Changes of the Milk. Almost all our Chyle and Drink is of an acefcent or oily Nature; but the Force of the Circulation destroys all Acidity in the human Body, attenuates all the oily Parts, and changes them both into the Nature of animal Salts, which are neither acid nor alkaline, but inclined to change into the latter, as we see in the Salt of Urine. Thus a Person who drinks Milk, discharges Part of it not under the Shape of Milk, but of Urine, which is yellow, salt, and destitute of its oily sweet Nature and white Colour, which were destroyed before any Passage was given for it thro' the renal Vessels. In the same Manner the Chyle, having circulated for the Space of twenty-four Hours through the Body of the Nurse, changes into an Ichorus, salt and urinous Milk, which, being tasted by the Infant, is not only refused, but it almost excites Convulsions; so much is this Milk abhorred by the Infant, as I have myself seen when the Nurse has been afflicted with a febrile Nausea. But if, when the Milk is thus disordered, the Nurse drinks plentifully of some Emulsion, Barley-drink, or Whey, she will afford good Milk.

¹⁷ Infants seldom use any other Food but that of Milk; and therefore the Accidents which happen to them are to be sought for in the Milk. When an Infant is afflicted with the Small-Pox, or an ardent Fever, it will be proper to give it Butter-milk which is a little sour; and the Nurse should be also supplied with the same Aliment. The Nurse should therefore, in these Cases, abstain from Fish, Flesh, and Eggs, which have all an Inclination to putrefy and turn alkaline; and she should equally abstain from any Thing salt and bilious: For, at that Time, the Fever is naturally intense enough,
and

and if the Nurse should live highly upon roast Meats, with Wines or strong Drinks, it would certainly be adding Fuel to the Fire; whereas, if she lives upon a thin Diet, as, for Example, skimmed Milk for her Drink, with Bread of Rye or Oats for her Food, the Infant will do very well. In these Cases, also, the Infant should be applied to the Breast always just after the Meal, or at least not Half an Hour after, that the Chyle may be drawn forth as crude as possible, before the acedent Quality of the Aliments has been changed; for in these Disorders, when the *Vis vitæ* is too powerful in the Infant, such Things ought to be given, as diminish the Violence of the Circulation and Attrition of the Vessels and Humours. But if, on the contrary, an Infant looks pale, is troubled with a cold, slow, and acid Disorder, its Breath, Sweat, and intestinal Fæces, smelling sour, while the Infant is frequently troubled with the Gripes; you will never be able to cure such a Disorder, without first changing the acid Nature of the Mother's Milk: For the Testacea here will afford only a short Truce, the Disorder soon returning, and the Acid proving troublesome, even to the Death of the Infant. In this Case, therefore, the Nurse should abstain from Bread, Milk, Tea, &c. which are acedent, and live altogether upon Fish, Flesh, &c. drinking strong red Wine; nor should she give her Breast to the Infant till six Hours after a Meal, by which Time the Aliments may be almost assimilated into our own Nature.

¹⁸ The Physicians of Courts, who have the Superintendency and Choice of the Nurses to Kings and Princes, usually press out a few Drops of Milk into a Spoon of Gold or Silver; and if a Drop of the Milk adheres to the Spoon without falling, they look upon it to be good, and well concocted.

concocted. It ought to be of a bluish Colour, for white Milk is too thick. But it should be quite free from any Smell and saline Taste, having a Sweetness somewhat resembling that of Sugar. But, notwithstanding all these good Appearances, the Physician may be egregiously deceived; for thus I have known very good Nurses rejected, and very bad ones chose in their Stead. For since the Fortune of the Nurse and the whole Family depends upon this Choice, they hardly durst eat or drink any Thing before the Tryal, for fear of injuring the Milk; to which add, the Anxiety or Care that they are under: But, by these Means, the Milk of the most healthy Woman may become brackish, and have something of an urinous Odour. When such a Nurse has been sent to be re-examined by me, I have ordered her to eat and drink plentifully, and to come to me again in a few Hours, when she has returned full of the best Milk.

§. 691. But to return to the Fœtus, which endeavours, by various Efforts, to forward itself in the Birth: As soon as it meets with the ambient Air, it opens the Glottis, *dilates* ¹ the Thorax, and admits the Air into its Lungs, which are thus *expanded* ² in all their Dimensions, their Vessels increase, or become more capacious, while their Resistance to the Blood of the pulmonary Artery is diminished: The Blood therefore will now flow freely into the dilated Arteries, without endeavouring to pass off laterally by the Canalis Arteriosus; and flowing swiftly and abundantly into the pulmonary Vein, it will press close the Valve of the ForamenOvale, so as to shut up that Opening,

ing, whereupon the whole Mass will enter the left Ventricle of the Heart, and be expelled from thence in the like Quantity; whence the Sides of the Aorta, being more dilated, will diminish, contract, and close the Opening of the Canalis Arteriosus. Thus the Blood of the right Auricle and venous Sinus will be all impelled into the right Ventricle, from whence it will be driven into the Lungs, where Respiration being performed as in Adults, the Membrane or Valve of the Foramen Ovale grows to the contiguous Edges of the membranous Partition, and the Canalis Arteriosus *changes*³ into a Ligament.

¹ The Infant endeavours by all Means to breathe, or admit the external Air, by dilating the Thorax, making its way, like a Mole, through all the Streights met with by the Mother and Midwife; nor does it cease until it is tired (§. 685.). Now when the Fœtus comes into the open Air, that instantly enters the Lungs, as soon as the Thorax is dilated, and changes them in such a Manner, that the Effect of that Change ever after remains during Life. In this first Respiration, the Water and Mucus of the Nostrils and Mouth of the Fœtus are generally discharged by sneezing, but in the second Inspiration, the Air enters the Lungs freely.

² We are furnished with extraordinary Experiments upon this Subject, in Consequence of a Dispute which arose between two celebrated Anatomists of *Amsterdam*, till, at length, there was an Order of the Magistrates to clear up the Matter from the Bottom. A Woman, unmarried, was delivered of a Child, which being found dead, the Mother was accused of murdering it; but there ap-
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pearing some Doubt in the Matter, and the Mother strictly denying the Fact, asserting, that it perished in the Birth; the Magistrates enquired of the Physicians, whether there was any Means, by Art, to determine this Doubt? The Physicians, taking the Affair into Consideration, answered in the Affirmative, that if the Fœtus died in the Womb before the Birth, its Lungs would then sink in Water; and that therefore the Success of this Experiment ought to clear the Mother: But that if the Fœtus had once breathed, or been brought alive into the World, the most skilful Physicians affirmed, that the Lungs would then swim. Hereupon, the Experiment was made, and the Lungs were found to swim; yet many Doubts were opposed to the Conclusion of the Physicians, on the Behalf of the Country. But the Physicians were certainly right in affirming, that so long as the Fœtus lives in Utero, it does not breathe; and that therefore its Lungs must sink in Water: But that, when it has breathed, the Lungs will then swim. For if there is any Air in the Lungs of the Fœtus, since Flesh is no heavier than Blood, which is only one twelfth Part heavier than Water, they must certainly swim. But the whole Lungs in the Fœtus are one continued compact Mass of Flesh; and in vain must the Fœtus in Utero endeavour to dilate the Thorax and depress the Diaphragm, since there is no Air to enter the Lungs, but this way the Liquor of the Amnios is rather sent more plentifully into the Stomach of the Fœtus; and even if the Uterus could be dilated, this Liquor would enter the Lungs instead of Air. But when once the Infant has drawn Air, the whole Lungs are inflated, and so changed by one Inspiration, that they are never after entirely void of Air. Even Lungs which have been deprived of

of their Air by the Pump, do nevertheless retain enough to make them swim above Water without ever subsiding. Hence it follows, that Respiration has rendered the Lungs specifically lighter, by increasing the Distances betwixt the Blood-Vessels, and by causing the Extremities of the Bronchia and Vesicles of *Malpighi*, to recede from each other; all the pulmonary Arteries increasing in the same Proportion as the Thorax is dilated, and the Humours, with respect to the whole Mass, are in a less Proportion. By Inspiration the Arteries are emptied, and, with the Bronchia, removed at greater Distances, so as to intercept larger Angles. For unless the Blood-Vessels were thus removed farther from each other, there would be no Reason why the Lungs should not subside or collapse, as at first. But since the Air-Vessels and Bladders of the Lungs are more expanded, the Blood-Vessels will be also enlarged, whence the Veins will be distended as well as the Arteries, and the increased Quantity of Blood in the Arteries will press upon that in the Veins; therefore now the Blood, expelled from the right Ventricle of the Heart into the pulmonary Artery, will not meet with that Resistance, as when the Lungs were collapsed. From hence, again, less Blood will pass by the *Canalis Arteriosus* into the Aorta; for only so much Blood will now pass from the pulmonary Artery through the *Canalis Arteriosus*, as the Blood meets with a greater Resistance in the Lungs than in the Aorta. But now when the Lungs are suddenly expanded, the Branches of the Artery will be capable of receiving more Blood; and the more Blood the Arteries receive, the more will pass by the Veins into the left Ventricle; for the Expansion of the Lungs will urge as much Blood through the Veins to the

left Ventricle, as it gives the Arteries an Opportunity of receiving more Blood by expanding or placing them at larger Angles. The more there is of Blood, therefore, passing thro' the Lungs, the more will pass to the left Ventricle of the Heart, and the more will come from the right Ventricle by the pulmonary Artery, from which Artery the left Ventricle of the Heart receives its Blood so much more plentifully, as that Artery is more expanded than before. Again, in the second Respiration, all the Blood is expelled from the pulmonary Arteries and expanded Lungs into the Veins, from whence it passes, in a direct Course, to the left Ventricle of the Heart, which receives more Blood in Proportion, as the pulmonary Veins are more compressed by the Blood, flowing more swiftly through the pulmonary Arteries, till, at length, none escapes thro' the *Canalis Arteriosus*, but all the Blood passes through the Lungs into the left Sinus. But the *Foramen Ovale* is in the Middle betwixt the pulmonary Sinus and the right Ventricle of the Heart, being furnished with a Valve, which closes towards the right Ventricle, but opens towards the left. This Valve, therefore, will now be pressed as well towards the Cava as towards the pulmonary Vein: For as now the Blood of the right Ventricle passes all through the pulmonary Arteries into the Lungs, and from thence into the pulmonary Vein, from thence the Valve of the *Foramen Ovale* will be pressed more close in Proportion, as more Blood is sent through the Lungs into the Sinus of the pulmonary Vein. Thus the oftener Respiration is repeated, the more powerfully will the Lungs be expanded, and the more closely will the *Foramen Ovale* be shut. But the *Canalis Arteriosus* is placed betwixt the Aorta and pulmonary Artery, to transmit the Blood, which

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in the Fœtus being propelled from the right Ventricle, meets with a greater Resistance in the Lungs than in the Aorta. But when the Fœtus has breathed, all the Blood of the right Ventricle of the Heart is sent into the left through the Lungs, without any of it passing by this intermediate Canal. Hence therefore the Aorta will be more dilated in Proportion, as the pulmonary Artery is more distended; whence the Sides of these two Arteries will approach nearer together, so as to compress and close this intermediate Canal, whereupon the Blood will continue its Course of Circulation in the Infant as in the Adult; namely, all the Blood will flow from the Cava into the right Ventricle, from thence into the pulmonary Artery, from thence through the pulmonary Vein, all of it into the left Ventricle, by whose Contraction it will be thrown into the Aorta.— Since all those Changes are evidently and naturally the Consequences of Respiration in the Fœtus, it gave me great Concern to find that the *Parisian Academy* should countenance and not condemn the Opinion of *Mery*, who has advanced but one Argument of any Force, which I am surpris'd to find unanswered by *Du Verney*. *Mery* urges, that the Blood cannot pass from the pulmonary Artery into the Aorta; because, if that happened, the Aorta must necessarily become larger than the pulmonary Artery, since Arteries are larger in Proportion to their distending Powers, and those distending Powers in Proportion to the Quantity of Blood impelled into the Arteries: And hence therefore, says he, it would have been impossible for the pulmonary Artery to be larger, if it received less Blood than the Aorta; and by this specious Argument accompanied with a Demonstration, that the pulmonary Artery was equal with

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the Aorta, he gained the Victory over *Du Verney* before a Committee of the Royal Academy. But his whole Argument is founded upon a Mistake in Hydraulics: For Example; Let there be two Canals equally resisting, marked *a*, *b*, and communicating together by an intermediate Canal maked *c*: If now a Liquor is urged along the Tube *a* towards the intermediate Canal *c*, none of it will pass through that Canal into the Tube *b*, unless the Resistance in the Tube *b* is less than the Impulse of the Liquor into *a*; for if the Resistance and Impulse is equal on both Sides, the Contrariety of the Pressures will destroy each other. Now the Lungs in a Foetus, considered as the lower Extremity of the Tube *a*, yield a greater Resistance than that of the Aorta or the Tube *b*; and therefore some Portion of the Blood in *a*, meeting with a less Resistance in *b*, will flow through the intermediate Canal *c*, till an Equilibrium is produced; after which, no more Blood will pass that way, the Resistance being the same in *b*, as in the pulmonary Artery. Hence it is evident, that *Mery* has made Use of a false Demonstration, since it is evident, that the compact Substance of the Lungs opposes as great Resistance to the Blood of the pulmonary Artery, as the whole Body opposes to the Aorta.

³ When an Infant is plunged under Water before the first Respiration, it may live a long Time, because it has the *Canalis Arteriosus* open; whence *Harvey* and his Expositor *Pitcairn* have been deceived. The *Harveyan* Problem is, why the Foetus is capable of living for three Hours after taken out from the Mother, provided it lies in the Chorion and Amnios entire; whereas when those Membranes are once broke so as to let the Infant breathe, it always perishes by plunging it
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under Water. We have an Instance, from *Leipsic*, of a Woman who was delivered privately, and immediately after buried the Placenta, Infant, and broken Membranes, under the Earth; but the Matter being suspected by some of the Family, was communicated to the Magistrate, by whom it appeared that the Woman was delivered three or four Hours before; and, being convicted, the Mother told the Place, from whence the Fœtus was taken up alive, without having suffered any Injury from the soft Earth. From hence it follows, that the Foramen Ovale, and Canalis Arteriosus, do not so suddenly close up, but that, if the Fœtus be plunged under Water, they may continue the Circulation without Respiration, as in a Tortoise or Frog, which breathe when they are out of Water, but, when they are under Water, the Blood passes thro' the Foramen Ovale and Canalis Arteriosus. It therefore only remains now to explain why we cannot breathe as well under Water as in the Air (§. 611.), and why we cannot dilate the Thorax under Water; but these Scruples we shall leave to be cleared up by Posterity.

§. 692. The Navel-string being tied near the Skin, nothing flows through its Vein into the *Liver*¹, but the Vein itself turns into a Ligament; and the Blood then in the Vena Cava, moving more swiftly, presses together the oblique Canalis Venosus so as to make it grow together into a Ligament, while, at the same Time, the umbilical Arteries, being also collapsed, are soon closed up.

¹ The umbilical Arteries in the Fœtus convey their Blood to the Placenta, from whence, again,

an equal Quantity of Blood is conveyed by the umbilical Vein either into the Liver or Vena Cava of the Fœtus, according as the Resistance happens to be greater in the one than in the other. So long, then, as the Infant coheres with its Placenta out of the Uterus, to which the Placenta as yet adheres, so long will the Blood be warm and pervious through the Placenta, the Mother in the mean Time, and the Fœtus, losing none of their Blood; and therefore the Fœtus, fastened by the Navel-string to the Placenta left in the Uterus, may live several Hours: Whence it is evident, that the Arteries of the Uterus exert a greater Force upon the Fœtus, than those of the Fœtus do upon the Uterus. If now the Navel-string be divided, the Infant will perish or bleed to Death thro' the umbilical Arteries, unless prevented by making a Ligature upon the Navel-string, by which those Arteries may be compressed, after which there is no more Communication betwixt the Placenta and the Arteries, Vein, and Urachus. But in the Fœtus all that Portion of the Blood sent downward from the left Ventricle of the Heart, enters the crural Arteries, except that Portion carried off by the umbilical Arteries to the Placenta; but these Arteries being now closed, all the Blood of the descending Aorta will descend through the lower Extremities, and return by the crural Veins into the Cava, from whence there will be made so great a Resistance or Pressure by the Blood to the Canalis Venosus in the Liver, that it will be stopped up, and the Circulation then continued through the Liver as in Adults.

§. 693. But Respiration being now begun, the black, tenacious, and shining Fæces of
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the Intestines called *Meconium*¹, from its Similitude to the inspissated Juice of Poppies, will be therefore discharged; and by the same Means, the Urachus being constringed, the urinary *Bladder*² will discharge its Contents through the Urethra as in Adults.

¹ We observed before, that the Stimulus from this Excrement is one of the principal Causes accelerating the Birth by Irritation; but now the Air being drawn into the Thorax and Lungs of the Fœtus, will enable the Diaphragm and abdominal Muscles to overcome the Resistance of the Sphincter of the Anus, by which the Fæces will be discharged: Whereas before, while the Fœtus lived invested on all Sides by the Amnios, it could not discharge any of the Fæces, which are never found in the Amnios; but whenever the Waters are fouled by the intestinal Fæces, skilful Midwives know that the Fœtus has then breathed.

² What has been said of the Sphincter Ani, is also true concerning that of the Bladder and its contained Urine. The Urachus in the new-born Infant is compressed by tying the Navel-string, without which Precaution the Child would perish; and in this Respect the human Species differs from Brutes, in which, the Navel-string being cut off at a moderate Distance, the Vessels close spontaneously without the Assistance of any Ligature. But God, having furnished Mankind with more Reason, has therefore laid them under a greater Necessity to exert it by the Assistances of Art. For if the Navel-string should be divided without making a Ligature, or if, by tying it with too slender a Thread, the umbilical Arteries should be again cut through, the Fœtus would certainly bleed to Death. But the more prudent Midwife makes Use of a broad Li-

gature, sufficient to prevent it from cutting, and yet narrow enough to make it draw tight, and compress the Vessels; and, at a small Distance from this first Ligature, she applies another as a Security, in case the former should slip off; and this being done, she then divides the Navel-string, dressing the End of it with a Piece of Paper spread with Honey and Oil of Rosès; after which the String mortifies and falls off, leaving a Cicatrix, which continues, during Life, under the Denomination of the Navel. Thus therefore a Ligature being made upon the Urachus, the Urine, about to escape from the Bladder, meets with a greater Resistance above than below; whereupon the Sphincter will be dilated, and the Urine allowed a Passage through the Urethra, without forcing itself away through the Urachus, as formerly; nor does the Urine ever after discharge itself that way through the Navel, unless by Disease.

§. 694. From all that has been said, we may deduce Answers to the following Questions.

1. What the *Father*¹ and what the *Mother*² contribute³ each towards the Procreation of their Species?

2. What are the Causes of Sterility in the *Male*⁴, *Female*⁵, and in *both*⁶ conjunctly?

3. Whether by any Art a true Child can be produced from the *Male*⁷ Semen only?

4. Whether any *Woman*⁸ can be fœcundated by any natural Cause, without associating with Man?

5. Whether the *menstruous*⁹ Blood is of a malignant or venomous Nature, or whether it is

is to be esteemed impure and excrementitious?

6. Whether a Woman makes any true Semen, which contributes to the Propagation of the Species?

7. Whether the Body of the Infant is formed by any *Mixture*¹⁰, Ebullition, *Fermentation*¹¹, or other *Action*¹², betwixt the Semen of both Sexes?

8. Whether we can *assuredly*¹³ determine the particular Part destined to Conception?

9. Whether the Woman contributes *Form*¹⁴, as well as Warmth and Nutrition, to the Fœtus? or whether this is demonstrated by the Power of the Mother's Imagination, when big with Child?

10. What *Fæcundation*¹⁵ properly is?

11. From whence the *three Membranes*¹⁶ of the Fœtus arise, both as to their Matter and efficient Cause?

12. From whence arises the *Placenta*¹⁷ and *Navel-string*¹⁸? and how the Embryo or Fœtus becomes fastened thereto?

13. Whether the Fœtus is nourished by the *Mouth*¹⁹, by the Navel-string, or by both? and what Changes it undergoes, at *different Times*²⁰, from Conception?

14. Whether the Fœtus has all its *Viscera*²¹, Vessels, and Limbs, formed at once? or whether it gradually changes its Form, assuming first the Nature of a Fish, then of an amphibious, and at last of a breathing Animal? or whether it admits Air, or breathes in the Uterus?

15. Whether it can evacuate its Intestines in the Uterus? and *why not* ²²? or whether the Meconium found in the Vagina denotes the *Death* ²³ of the Fœtus, or what else?

16. Whether or no *Superfætation* ²⁴ can happen? and why but very rarely?

17. Why Twins, or three or four Children, seem to an unwary Person to adhere only to *one Placenta* ²⁵, though each of them are always furnished with distinct umbilical Chords, and included each in distinct Membranes? Whether this is the Consequence of so many Ova adhering only to one *Calix* ²⁶? or whether this is always found true, Twins being often observed conjoined together?

18. From whence arise *Nauseas* ²⁷, Sickness, Vomiting, Faintings, Shiverings, vitiated Appetite, Hardness of the *Breasts* ²⁸, with Pain and Tumor of them, a wasting of the Habit, a Retention of the Menses, a Difficulty of breathing, a Cough, *Varices* ²⁹ in the Feet, Legs, Thighs, and Abdomen, and a Propensity to *tumble* ³⁰ forward by a slight Force?

19. Whence it is that the *Fœtus* ³¹ sleeps quietly in the Womb connected to the living Mother, and invested on all Sides within the Amnios? and why the Fœtus endeavours with all its Power and Efforts to breathe, so soon as this Communication betwixt the Mother and itself is destroyed by a Separation, a Wound, or the Death of the Mother?

20. Whence

20. Whence it is that the Fœtus is often found living in the Womb above *Half an Hour*.³² after the Mother has expired?

¹ The Father communicates the Embryo and first Rudiments of Life, the Structure of the Body being already determined and assigned in the Animalcules of the male Semen in all Creatures, which yet receives some Alteration according to the different Species of Animal or Female from whence it is nourished. The Male likewise contributes the first Aliment, namely, the Juice of the prostatic Gland, by which it is supported even to the Ovum of the Female.

² The Mother receives the living Rudiments of the Fœtus from the Father, retains and nourishes the same, affording therefore a Habitation to the Fœtus, and Nourishment by the Liquor of the Amnios in which it swims, after being separated through the Vessels of the Chorion. That though the Female be viviparous, yet she lays, incubates, and nourishes, an Ovum within the Uterus, in the human Species, for the Space of nine Months, and in Elephants for the Space of two Years; whereas in oviparous Fowls the Incubation is completed in twenty-one Days.

³ This first Rudiment of the Fœtus, supplied by the Father, does not therefore contain all the Viscera as we find them, but they are by Degrees formed or unfolded in a wonderful Manner. In the Year 1661, *Thevenot* invited a Convention of learned Men to his House at *Paris*, in order to promote Knowledge by their Disputations; among whom *Swammerdam* being present, the Subject happened to be upon the Generation of Animals; concerning which every one having given his Opinion with respect to the Formation of the Viscera,

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it came, at last, to the Turn of our Citizen to speak, who being no Orator, though extremely well qualified for the Subject, rather chose to explain the Matter by Experiment, than by Reasoning. At the next Meeting, therefore, he brought a Silk-worm, and desired the Company to find out its Butterfly Wings, which they all endeavoured to no Purpose, till at last he, with great Dexterity, unfolded the latent Wings with the Proboscis of the future Butterfly; by which it appeared, that Nature had a long Time before formed those Parts, which were to be afterwards unfolded and brought to Light. That the same takes Place in the human Species, we are taught by the Embryo, which seems at first to have neither Legs nor Arms, when, at the same Time, it has both concealed, and, in Process of Time, unfolds and brings them to Light. The Animal, then, is derived from the Father; but from whence does he receive it? Its Residence is certainly in no other Part besides the Testicle, and the Passage which leads from thence into the Urethra.

⁴ Namely, an Extinction of the Animalcules vivifying the genital Humour. This has been demonstrated by particular Experiments, particularly by Castration. Men, by an ingenious Cruelty, have been taught to make Eunuchs, to satisfy their particular Intentions; but in these the Testicles only are destroyed, or at least injured so that they can no longer perform the seminal Secretion; for they have both the Penis and prostate Gland, only the Animalcules are absent, from whence they are rendered sterile.

⁵ When either the Ova are wanting, or vitiated with a Scirrhus in the Ovary, which is a very common Disorder; for nothing is more frequent, upon opening the Bodies of sterile Women, than to find a scirrhus Hardness of the Ovary, or a Disten-

Distension of it with Hydatides. But the Ovaria may be likewise extirpated, as we observe in Sows : For though these are afterwards inclined to Venery, yet they have never any Young after the Ovaria are cut out. To these Causes add an Obstruction of the *Fallopian* Tubes. Again, the Uterus may be either too dry, or replete with too much Blood ; or the Fundus of the Uterus may be so disposed, as to prevent the Placenta from fixing itself there, or so that the Uterus cannot expand itself ; which last is an Accident observed an hundred Times by *Harvey*. *Hippocrates* well observes, that Women often do not conceive, because the Uterus is afflicted with a Flux or mucous Discharge, which may be cured by the strongest purging Medicines. I have often observed the same Event after a long Continuance of the Fluor Albus, having recovered the Patient with a drying Diet, Myrrh, Rhubarb, and Tamarinds, as *Charleton* has well advised ; for, by these means, the Ovum is better retained, than when the Uterus is too much lubricated. If the Disorder should have proceeded from a Scirrhus of the Uterus, Laxatives and the Use of warm Baths will be serviceable.

⁶ Of this we had a famous Instance in *France*, where a certain Nobleman having lived a long Time in a conjugal State, but sterile, there being no Fault from the Side of his Lady, they were at length separated by Order of the supreme Court ; and the Lady taking another Husband, and the Nobleman another Wife, they had both of them Children. Whence it is evident, that Fœcundation often depends upon a mutual and relative Disposition both of the Father and Mother with respect to each other, though there may be no Defect in the Man or Woman separately. In brute Animals this Observation is frequently true, when the
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most generous Horses do not impregnate some Mares, which yet easily conceive from other Horses.

⁷ Thus *Paracelsus* has affirmed, that a Child may be produced, so as to be free from original Sin, having indeed a slender Body, but an exalted Mind, skilled in all Sciences and Secrets, and that it may be nourished by the Quintessence of Bread. But these are mere Dreams; for there is neither Animal nor Plant capable of being propagated by the Male only.

⁸ This is confirmed both by the public Judgment and repeated Instances, that it is possible, and has sometimes happened, that the Woman has conceived either in the Absence of her Husband, or after he has been dead, without Adultery, only from luxurious Dreams and a vivid Imagination: But then I shall not believe, till an Instance is given me, that a Woman can bring forth a Fœtus from the Ovum which she has conceived, without associating with the Male. I know there are some Women crafty enough to persuade the Credulous, that they became with Child of themselves; and that there are others who have been reputed to conceive and bring forth, from what has been taken up by them in washing in a Bath, as *Plutarch* relates of *Theseus*. But certain it is, that nothing of this Nature happens naturally; and we are not here treating of the supernatural Power of the Creator. It is even evident, that the Association of the Male with the Female is so necessary in Animals of the same Kind, that, by matching of different Species, Monsters only are produced, incapable of propagating their Species. When a Cock Pheasant is matched with a common Hen, a mixed Kind of Fowl is hatched from the Eggs, very fit for the Table, but incapable of propagating their Species.

⁹ This whole Theory has been derived to us from *Asia*. There People live idly, are of a soft Habit, and addicted to sit still on account of the Heat; and the Women have generally their Menfes very largely. Sometimes a Part of the menstruous Blood remains in the Vagina, and in these hot Countries degenerates into an ill-smelling putrid Mass in the Space of six, eight, or ten Hours. Even the Blood of a Pigeon applied to the Head of an apoplectic Patient, does in these Countries stink intolerably in a few Hours Time. From hence arose that Detestation of the menstrual Discharge; and from hence Bathing is ordered to the Women by the universal Consent of all People inhabiting the hot Countries of *Asia*, *Africa*, and *America*. I have even observed something of this Nature among unclean Women in our own Country, when they have had their Menfes in the Summer-time. If now a Man associates with such a Woman, having putrid Blood stagnating in the Vagina, and heightened as well by the venereal Heat as that of the Air, they will both of them be invaded with malignant Disorders of the genital Parts, though they may be different from the true *Celtic Lues*. From hence arose the infamous Reflections which have been cast upon the menstruous Blood; and for the same Reason, and no other, did *Moses* give that wholesome Precept, That a Man should not associate with a Woman during the Time of her Menstruation, which, if done contrary to the Law, should be a capital Offence; and he prefixed a certain Number of Days to be expired, as well after the Birth, as after the menstrual Flux, which being expired, the Women might, after Bathing, admit their Husbands. The *Jewish* Priests, who had been a long Time addicted to Superstition, have so much increased the ill
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Opinion of the menſtruous Blood, as to pronounce even the Effluvia thereof venomous, and endowed with a corroding Power; inſomuch that the Root *Baara* growing about *Jeruſalem*, and incapable of being pulled up by any Force, even of *Hercules*, will nevertheless be extirpated (ſay they) if a menſtruous Woman deſcribes a Circle by walking round the Root. They alſo have a received Notion, that a Looking-glaſs will be diſcoloured with Spots, and that the Quickſilver will come off from behind, if a menſtruous Woman looks in it. But how much wiſer than theſe was *Hippocrates*, who tells us, that the menſtruous Blood of a healthy Woman flows to the Quantity of three Fourths of a Pint, of the ſame Kind as we obſerve flow from an Animal killed for the Altar; namely, freſh and very pure: For unleſs the Animal was perfectly ſound, it could not be offered up as a Sacrifice. But at length the extravafated Blood may putrefy, when it ſtagnates betwixt the Folds or in the Sinuſes of the Pudenda. In the ſame Manner, alſo, the Males themſelves are, in the hot Countries of *Aſia*, *Africa*, and *America*, obliged to circumciſe or cut off the Prepuce, unleſs they will be troubled with very bad Diſorders about theſe Parts: But it cannot be therefore inferred, that there is any Virus naturally in the Prepuce, becauſe ſometimes a morbid Corruption or Collection of putrid Humours is there ſeated.

¹⁰ It is the common and received Opinion, that the Semen of either Sex is of itſelf unprolific, but that, when mixed together, they form the Rudiments of the Fœtus. The Weakneſs and Inconſiſtence of this Opinion, though evident, is yet ſupported by *Carteſius* and *Craanen*, who urge, in Behalf of it, Experience; ſince the Woman, affected by Venery, diſcharges a Juice reſembling the Male Semen.

Semen. But since the Observations of *Lewenhoeck* and *Malpighi*, it seems evident, that the Offspring is received by the Mother from the Male, and that she does not contribute any Semen which is necessary to mix with the former towards Generation; yet so that without the Uterus of the Mother, the Male Semen would never be capable of producing any Thing. For Anatomists observe, that the Vessels from whence the mucous Humours of Women burst forth, when they are affected with Venery, do all of them terminate in the Vagina, and that they do not discharge any Thing into the Cavity of the Uterus; yet this lascivious Humour is discharged from the Pudenda, under the Appearance of Male Semen.

¹¹ *Drelincourt*, who has given us a most accurate Description of the genital Parts in Women, has taught, in his excellent Book *De Conceptu*, that the Male Semen is replenished with a volatile oily Salt, which vivifies the unactive Mass of the Mother's Semen, and renders the same prolific. But the Semen Masculinum is so remote from a volatile Nature, that there is hardly any other Humour in the Body so viscid; and it may be retained for whole Months and Years, without exhaling any Thing of its Virtue, in Men who live abstemiously.

¹² There seems to be no other Action than that of uniting some of the vital Semen of the Male with the Ovum of the Female; whence it appears, that the Term Conception is extremely proper, and that it is elegantly said in the *Hebrew Text*, that *the Offspring of Adam came from his Loins*; but that *when Eve knew Adam, she conceived, and brought forth*.

¹³ In multiparous brute Animals, the Uterus is divided into two Horns, which in their Extremities send forth each a Tube; so that, in these Brutes,
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Conception is performed in the Ovaria. But concerning the Cause of Conception there are two Opinions: The first is that of *Harvey*; who, finding none of the male Semen in the Uterus of Brutes, opened after Venery, has taught, that the fecundating Power of the male Semen is absorbed by the Blood, and conveyed by the Circulation to the Ovary to fecundate the Ovum: So that, according to this Opinion, the Ovum can never be fecundated after it has been once separated from the Ovary. The other is the Opinion of those who teach, that the Uterus of the Woman who conceives, closes and retains the male Semen, the more noble Part of which passes thro' the winding Tubes to the Ovarium, where it enters and occasions Conception. But if the Ovum is separated from the Ovary, I see no Reason why it should not be fecundated in the *Fallopian* Tube, or in the Cavity of the Uterus itself: For, in my Opinion, there is no determinate Place of Conception, but that the male Semen meets and impregnates the Ovum in some Part, more especially in the *Fallopian* Tube; for Fœtuses have been found both in the Ovaria, in the *Fallopian* Tubes, and in the Entrance of those Tubes into the Uterus; and, lastly, in the Vagina itself.

¹⁴ Natural History furnishes us many Instances which seem to prove, that the Mother governs the Form of the Fœtus; and though they may seem fabulous or incredible, like the History of *Lucian*, yet they as certainly happen as Things which are the most evident. You will perhaps object, that if the Mother contributes nothing to the Rudiments of the Fœtus, how can she alter its Form? To this we answer, that she cannot at Pleasure alter the Fœtus; for if her Will could have any Power in this Respect, how many Mothers would change their Daughters into Sons, or their
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Sons into Daughters : But the most powerful Imagination seems to have here no Efficacy ; for I have seen Women who have for several Months declared they should bring forth deformed Children, because they had continually in their Mind the deformed Shape which they expected ; and yet, after all these Complaints, I have known them bring forth healthy and beautiful Children. It is not here denied, but that the Imagination may change the Fœtus in any Month of Gestation, when it arises suddenly with a Fright ungoverned by Reason. The Horror, thus produced, is an inseparable Companion of the foreign Change introduced ; for the Horror arises from the Force which is about to produce a Fever : Thus we have a Horror or Trembling at a miserable Spectacle, and in general it always happens when our Blood and Humours are put into an unusual Motion ; but now from this Horror the Fœtus suffers the same Alteration in its own Body with that which happens in the Body of the Mother. Thus I saw with mine own Eyes, in a very wise Lady of the first Rank, that a Mulberry falling upon her Nose from off the Tree, under which she was walking, immediately the Figure of the unlucky Berry was painted upon the Nose of the Embryo, perfectly expressed in Magnitude, Colour, and Roughness, with small round Portions and Villi ; and this Impression returns and appears vivid, every Year when the Mulberries are ripe. In this Case nothing more was done than slightly touching the Mother's Nose, and yet from thence followed so considerable an Alteration in the Fœtus. If it be objected, that this Sign might have happened in the Nose of the Infant, if the Mother had not been thus surprised by the Mulberry ; it will be advancing nothing that seems probable

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bable or worthy of a Philosopher. I know well, that *Blondell* has, in a sarcastic Style, opposed this Power of the Mother's Imagination; but our not understanding the Causes of any Phænomenon, is no Argument against Matter of Fact itself. In another Woman who was sewing or intent upon some such Business, when she suddenly looked up, and saw a Beggar standing before the Window with a frightful Hair-lip and a Fissure in the Palate, she was seized with a Horror or Trembling; and tho' she had before been delivered of beautiful Children, yet she was now brought to bed of a Child, whose Palate and Lip seemed to be so lately divided, that they discharged Blood. I am acquainted with another Man whose Mother being surpris'd at seeing a Hand with six Fingers, which was shewn to her by a Beggar, he was himself brought forth with six Fingers upon one Hand, for which there was no other probable Cause. From hence then it is evident, that the Mother can add, diminish, or change, several Parts in the Fœtus, not from her Knowledge, Will, or Refusal. But though these are Matters of Fact, and cannot be denied, without we will desert our Senses; yet it does not thence follow, that the Mother forms the Fœtus by her Imagination, as the Potter forms the Clay, according to the Opinion of *Stabll* and his Followers. For these Changes are produced by an unknown Power, incapable of being put in Action, or of being suppressed by the Influence of the Mother's Will. A Woman with Child fell down in her Chamber, and brought forth an Infant with a large Wound in the Vertex of its Head, in the same Place and of the same Figure which the Mother received in the back Part of her Head by the Fall; and there are many such Instances which are not

fabulous. There was a wonderful Accident of this Kind at *Brussels*, when the *Dutch* Noblemen Count *Egmond* and *Horne* were beheaded by Order of the Duke of *Albani*. Among the Spectators was a Woman with Child, who, not without Terror, saw the famous Warrior Count *Egmond* perish; but this Woman was afterwards delivered of an Infant without a Head, the Neck being as yet bloody; the wonderful History of which came to *Helmont* (who lived at *Brussels*), confirmed by the public Magistrate. At *Paris* there was a Woman with Child, who seeing a Malefactor broke upon the Wheel, brought forth an Infant with all its Bones broke in the same Manner. In these Cases there is something which does not at all agree with the Laws of Nature, as they are at present known to us; and yet the Facts cannot be denied, unless the Laws of Nature were perfectly known to us.

¹⁵ Fœcundation then consists in the Entrance of the male Semen or Animalcule into the Ovum of the Female.

¹⁶ There have been some Philosophers who have taught, that the Froth of the feminal Liquors of both Sexes, mixed together, formed a thick Skin, made up of three Membranes, and that the Fæces deposited formed the Placenta. But *Drelincourt* has taught, that the Ovum is already furnished with the Chorion, Amnios, and Rudiments of the Placenta or Corpus Luteum, while it continues in the Ovary; and that therefore all these Parts are derived from the Mother.

¹⁷ The Placenta is the Calix or Foot-stalk of the Ovum already formed in the Ovary, and by which the Ovum is connected and nourished.

¹⁸ What the Funiculus Umbilicalis is, or how derived, I am indeed ignorant; for there is not any

Rudiment or Sign of this Part to be found in the Ovum, nor yet in the Animalcule of *Lewenhoeck*; nor do we receive any Light into this Matter from the most accurate Figures of *Malpighi*. We are indeed pretty well assured that the Ovum belongs to the Mother, and that the Embryo is derived from the Father; but we still remain in the Dark as to whether the Navel-string being connected to the Embryo comes out from his Abdomen, as it may indeed be said to do with respect to the umbilical Arteries and Urachus, but not with respect to the Vein, since we know not how a Vein can come forth and insert itself into the Body. If you reply, that the Funiculus Umbilicalis comes from the Placenta, we then ask, From whence come the Arteries? So that there are insuperable Difficulties on both Sides.—But I am well assured, that there are Laws prescribed to created Beings; so that Seeds never take Root but in their proper and agreeable Earth: Thus the Mosses and some Plants grow only upon Walls, other Plants take Root only in the Water, some grow only with their Roots spread into hard Stones, others with their Roots growing into several Sorts of Trees, &c. Who will explain why Mistletoe is found growing no where but upon some other Tree? and why its mature Seeds never take Root but in some Cleft of the moist Bark, which if allowed it grows up to a large solid Tree, loaded with Flowers, Fruit, and Leaves? These are Parts of Nature's Oeconomy, which we see and do not understand. In the anatomical Collections or Treasury of *Ruysch*, bought by the Empress of *Russia*, there is a compleat Collection of Fœtuses from the very first Instant of Conception even to the End of the ninth Month. In surveying these I have

have spent many Days, and always found that the Funiculus Umbilicalis was larger in Proportion as the Foetus was nearer its Origin, and the Reverse. Even in a Foetus no larger than the smallest Ant, I could perceive the little Animal sitting upon the acute Point of a Cone, which formed the Navel-string. It is therefore probable, that the Stamen Masculinum, or incipient Animal, insinuates itself through the Placenta, from whence it passes into the Funiculus Umbilicalis to which it adheres, so that the Navel-string then conjoins the Foetus and Ovum together: Or rather one Part of the Chord comes from the Foetus, and the other Part from the Placenta; namely, the Arteries from the former, and Veins from the latter, which growing together, form one Chord. But, after all this, we are obliged to say with *Helmont*, “ I have
“ sowed, said he, the Seed of a Pine in the Shell,
“ and the Root comes forth through the Shell,
“ descends into the Earth, and there breaks up
“ the Shell, and raises itself into a Stalk.” All this we experience, but cannot explain.

¹⁹ The Foetus is in a great measure nourished by the Mouth; and the whole Skin of the Foetus is so thin, that no one can deny but a Liquor may transude through the cutaneous Arteries, and be again absorbed by the Veins: For thus are Plants nourished by their whole Surface, since after languishing in the Day, they appear turgid and fresh in the Morning from absorbing the Dews or moist Vapours of the Night. The Foetus therefore takes in Aliment by the Mouth, digests the same in the Stomach by means of the Saliva, Bile, Juice of the Pancreas, Stomach, and Intestines. The Chyle from thence formed passes through the lacteal Vessels into the venal Blood, as I had once an Opportunity

tunity of seeing by the naked Eye, in a Child whose Abdomen was split open from the Mother's Imagination, so that the Intestines came through the Wound, and the lacteal Vessels might be seen filled with Chyle as plainly as in Adults. The Fœtus is therefore truly nourished by the *Primæ Viæ*. But by the Placenta is returned to the Mother that Blood, which, having suffered no Action of the Lungs in the Body of the Infant, requires to be attenuated by those of the Mother, who on the other Hand returns as much Blood already prepared by her Lungs to the Fœtus by the umbilical Vein. This Doctrine is easily reconcilable to that of *Hippocrates*, who tells us, that the Fœtus is nourished two Ways.

2^o If the Animalcules of *Lewenhoeck* are the Embryos of future Children, they then, doubtless, receive their first Nourishment in the Testicle, Epididymis, Vas Deferens, seminal Vesicles, and Urethra, of the Male; and afterwards in the Mother's Womb, they are first nourished by the Juice of the prostate Gland, which seem to nourish the Fœtus, until it is capable of providing for itself, before it is feasted or supplied by the Mother. But when the Ovum is fœcundated while it still adheres to the Ovary, it is then nourished only by the preceding Juice and that of the Ovum itself; but when the Ovum is freed from its Foot-stalk, and retained in the Uterus, their Surfaces being not yet contiguous nor conjoined, during that Time the Fœtus may be nourished by the Liquors there imbibed through the Membranes of the Chorion and Amnios.

3^o The Formation of the Viscera is directed by some surprising Power. When *Epicurus* and *Lucretius* teach, that all Things are made of the same Matter

Matter or Atoms by one common Principle, namely, Gravity infused throughout the same Matter, whose Atoms are supposed lying in an indefinite void Space; I would desire of these, and such like Philosophers, to resolve me how the Animal successively puts on different Forms perfectly agreeable to the Aliment upon which it is to live. I have often seen a Sort of curling Eels in the Semen of various Animals; and it is certain, that in the Frog-kind nothing is communicated from the Male to the Female but a small Animalcule or Worm, which by Degrees swells into a Tubercle, from whence spring the Limbs; and if the Observation be continued through other Animals, all of them will be found small Worms at their Original. Who would believe that a Butterfly, furnished with four Wings, six Feet, and innumerable Eyes, was once a Sort of Worm or Caterpillar? All Sorts of Grasshoppers and Flies were formerly Worms. *Swammerdam* formerly, with great Dexterity, took out and displayed the Butterfly or the Silk-worm, demonstrating its Wings, Legs, and other Parts, which lay concealed in the State of a Chrysalis or Worm, as we observed before, when he met at a Consultation among the Learned in the House of Mr. *Thevenot* in *Paris*. But even Man himself was once a Worm, as the Prophets speak, when they endeavour to humble human Pride. But from this Worm throwing off the Coverings, a new Animal is produced; so that from a Chrysalis or Grub, comes forth a living and volatile Butterfly. If these Changes were not demonstrable to the Senses, a Man would be termed mad who should propose such Paradoxes: But what I have seen I faithfully relate, having no Reason to deceive my Pupils; namely, that I have observed a

small Foetus without either Arms or Legs, no larger than an Ant, yet generated from the Male, and conceived by the Female, who discharged it by Abortion. In another Abortive which had lived a little longer, I observed the Head with a small Tail terminating at the Coccyx, in which appeared small Tubercles, from whence the Arms and Legs were to arise. *Malpighi* has demonstrated, that every Chick appears at first to be nothing more than Brain, Cerebellum, and spinal Medulla, the two Eyes also appearing visible. If you examine the accurate Figures of *Malpighi*, you will see the incipient Chick to be at first no more than a Worm, after which appears the Head and Eyes. Afterwards from thence there appears a hollow Tube with the Heart and several other Viscera in Order. At first all the three Venters appear open, and the Heart itself attached to the Spine is naked, and undefended with the Ribs. The Heart itself appears at first a crooked Canal, which at length dilates into four Sinuses, namely, the Auricles and Ventricles, which by Degrees are fastened together in distinct Order, after they have continued a considerable Time separate; for the unequal Canal being every Day more contorted, forms, at length, two Auricles and Ventricles conjoined together into one Heart. After this the Ribs appear, the Thorax is closed up, and then the Lungs and Liver begin to appear, which hitherto lay concealed; it is therefore evident, that these Viscera were not present at first in the incipient Animal, though it contains the Matter from whence they are formed. The Heart, thus formed, hath, as it were, but one Ventricle, so long as the Chick does not breathe; for the Communications of the Vena Cava with the pulmonary Vein by the Foramen Ovale, and

and of the pulmonary Artery with the Aorta, make the Heart, as it were, consisting of but one Ventricle, as in amphibious Animals; and even in the Silk-worm the Heart is single, but divided into Portions, as *Swammerdam* has demonstrated, in Opposition to *Malpighi*. However, the Lungs, as yet useless in the Chick, grow, become more perfect, and are furnished with all their Vessels. Until the Birth therefore, Man, who was before a Worm, continues an amphibious Animal capable of living in the midst of Water without the Use of the Lungs; but after the Birth he becomes a breathing Animal, having, as it were, two distinct Hearts, and becoming lifeless, if he is excluded from the Air for the Space of seven or eight Minutes Time. But that he does not breathe in the Uterus, is evident from the Experiments of *Vesalius*. For Example: Let the whole Birth or Ovum be taken out of a dead pregnant Cow, and laid upon the Table, the Calf will then appear variously moving and struggling within, in order to make itself a Way out; and in the same Manner Chickens make a Noise and peck the Shell, to make themselves a Way out. As soon as ever the Chorion and Amnios are divided, the Fœtus always breathes, and then becomes quiet enough. Those Fœtuses which are turned in the Womb generally die; for if they are not immediately excluded into the Air, some Part of the Membranes may easily adhere to the Mouth, and suffocate the Fœtus.

²² The intestinal Fæces of the Fœtus are never found discharged into the Cavity of the Amnios in the close Uterus, though the Meconium is then found abounding in great Quantities in the Rectum: The Reason of which is, that the Resistance of the Sphincter cannot be overcome without Inspiration.

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²³ At the Birth of the Fœtus a pure Water is discharged, nor does the Fœtus deposit any of its intestinal Fæces by its most violent Struggles, unless the Air enters the Uterus, and, reaching the Fœtus, gives it Opportunity to breathe, and then the Meconium is always found discharged: So that from the Appearance thereof one may conclude,

1. That the Membranes are broke, the Waters discharged, and that the Infant has breathed.
2. That the Infant lies in the Mouth of the Uterus in such a Manner, as to give the Fæces an Opportunity to come out that way. In this Case the Fœtus is in the greatest Danger of Suffocation, inso-much that there is hardly one in twenty, of those saved, who discharge the Meconium before they are delivered: For if the Air which has once entered the Thorax be denied a free Passage, so as to hinder the Infant from breathing but a short Time, it must inevitably perish. This is therefore no sure Sign that the Fœtus is dead; for when Surgeons trust hereunto, they often butcher and extract the Fœtus by Hooks, while it is yet alive and breathing; of which we have several Instances in *Mauriceau* in his Observations upon Women with Child, which I prefer much to his other Work concerning the Practice of Midwifery. It were to be wished that we had either good Midwives, or none at all. When they begin to have a Name, they are always in a Hurry, and break the Waters, that they may extract the Fœtus; whereas, on the contrary, it is the Office of a good Midwife to retain the Waters entire as long as possible; and if unexpectedly there should appear a Discharge of the Meconium, to procure a free Passage for the Air to the Fœtus by the Hand, that it may not be suffocated, to avoid which the Os Uteri is to be dilated by the Fingers.

²⁴ I cannot think Superfoetation possible, unless at that Time, when the Ovum received into the Uterus is so small, that it does not on all Sides adhere to the concave Surface of the Uterus. Those Superfoetations which happen at any other Time do not deserve the Name, nor are they properly such, namely, two Impregnations, the latter of which is made some Time after the former. For when the Ovum fills the whole Uterus, I cannot see how the Semen can enter, unless we allow the *Harveyan* Hypothesis of the Semen being taken up by the Blood, and by that conveyed to the Ovaria, instead of passing through the Uterus and *Fallopian* Tubes. But if we admit this Hypothesis, I can see no Reason why we should not always have Superfoetations, unless it be allowed or assumed, that after the Uterus has conceived it has no bibulous Veins, or is not capable of absorbing any of the Semen. But if in the third Month after the Delivery of a Foetus, another Birth follows, as sometimes happens, and as I have myself seen; the second is always poor and lean, or half withered: Namely, there were Twins, one of which grew largely, and was excluded at its full Age; but the other continued afterwards, and fell away in the Uterus, in the same Manner as a Placenta shrinks after it has been retained for some Months in the Uterus.

²⁵ This I have always found true in the natural History of *Germina*, and is confirmed by the *Ruyschian* Collection of Foetuses; namely, when Twins are conceived, in the first Month of Gravitation there are two orbicular Placentæ, which by Degrees become semi-orbicular, till they at length form, as it were, one, which is never absolutely a single one, but two conjoined together; and if there

there are three Fœtuses, there will be three Placentæ, which in Time grow together into one Mass like the former. It is not therefore true which is commonly supposed, that Twins have only one Placenta, and two Navel-strings: But there are really two distinct Placentæ conjoined together, each of which is furnished with its Navel-string. And this is always the Case, though the Ancients, being less curious in examining into the Minutiæ of Things, believed otherwise. Nor was there ever two Fœtuses observed in one and the same Ovum. We may, in these Cases, very well rely upon the Observations of *Mauriceau*, because at *Paris* Women are taken into the *Hotel Dieu* fifteen Days before their lying in at the public Expence, so that the Business of Midwifery can be no where better learnt.

²⁶ The Egg of a Hen has sometimes two Yolks, and, in that Case, there are always two Sacculi of Colliquamentum, and they produce two Chickens, each adhering to its Placenta; but if the Yolk is single, it produces but one Chicken.

²⁷ These follow from the Alteration made in the Circulation of the Blood; for the very same Appearances sometimes happen in Virgins, barely from a Suppression of the Menfes. For after three Weeks the Ovum becomes as large as the Cavity of the Uterus, so as to prevent the Discharge of the Menfes hitherto collected; but at this Time the Fœtus hardly weighs two Ounces, and therefore the menstruous Blood, being retained, will cause a Plethora at that Time, because the Fœtus is not yet large enough to receive it. Hence Abortions most frequently happen about the third Month, or when the third Return of the Menfes is expected; and there will be greater Danger of Abortion, in
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Proportion as the Mother was before used to a larger menstrual Discharge. From hence follows a Nausea, Difficulty of breathing, &c. and in the mean Time the Uterus extending, changes its pyriform Shape into that of a Sphere, ascending into the Abdomen, causing, by its Pressure, Varices in the lower Parts, Costiveness, a Difficulty in making Water, the Piles, &c. For the Uterus must thus of Necessity compress the adjacent large Vessels and Viscera; and therefore Women who have the Bones of the Pelvis flatter, and the iliacal Veins more exposed, are more especially afflicted with Varices, an Inflation of the Lips of the Vulva, with a Swelling of the Legs and Thighs. But the common Cause of these Symptoms is a Compressure of the Veins obstructing the Return of the Blood; but these Symptoms vary, in Proportion as the Woman has a larger or less Pelvis; for those which have the largest are the happiest. Add to this, that the Fæces are sometimes indurated to such a Degree in the Colon of the Mother, that they are sometimes retained as long as they live.

²⁸ The Blood and nutritious Juices are sent upward to the Breasts, which have a Consent or Communication with the Uterus.

²⁹ The Veins themselves are sometimes distended to above the Thickness of an Inch, and burst open with fatal Consequences, if they are not prevented, as they easily may by Compressure. But there is also a troublesome or difficult discharging of the Urine from the same Compressure of the Bladder.

³⁰ This follows, because the Center of Gravity is removed more forward; but these Falls are dangerous to the Foetus.

³¹ This is a beautiful Experiment of *Vesalius*, which is always found to be true, and agreeable

to all modern Experiments. If a Bitch be opened towards the End of her Gestation, a little before she whelps, the little ones will appear quiet; but so soon as the Mother is perfectly dead, all of them begin to move together, though they have no Dependance upon each other: But the Cause of their struggling proceeds from the Removal of the Commerce and Communication betwixt themselves and the Mother. In the same Manner, if a Sow be opened, and one of the Pigs taken out from the Amnios, that will lie quiet, while all the rest continue to struggle, until you likewise divide their including Membranes.

³² This Experiment has been often made at *Paris*; and the Reason thereof is, the twofold Circulation may be carried on by means of the as yet open Foramen Ovale and Canalis Arteriosus: So that thus the Fœtus will live, though not with so much Ease.





Of PATHOLOGY¹, or the
Nature of DISEASES.

§. 695. **W**E have hitherto described and *explained*² the principal Functions or Actions performed by the several Parts of the human Body by the *Motion*³ of the Humours through the Vessels, and by the *Re-action*³ * of the Vessels upon those Humours; and we have likewise pointed out their Causes. These Actions, commonly called *Functions*⁴, are usually distinguished into vital, natural, and animal; those peculiar to each *Sex*⁵, and subservient either to some *private*⁶ or *public*⁷ Use. The *vital*⁸ Functions are those without the immediate Assistance of which Life cannot subsist; such as the muscular Action of the *Heart*⁹, the secretory Action of the Cerebellum, the Motion of the Lungs in Respiration, and of the Blood and Spirits through those Organs, circulating by the Arteries, Veins, and Nerves; though it is evident these may be diminished or increased, as to their Perfection, without destroying Life; and even after the Heart itself has been cut out, there still remains not only a kind of Life, but also Motion, and even a Power of running
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in the Animal, though that be of a very short Duration. The *natural* ¹⁰ Functions are those by which our Aliments are changed or assimilated to our own Nature, so as to become Part of ourselves; and such are the Actions of the Viscera, Vessels, and Humours, which receive, retain, move, change, mix, separate, apply, discharge, and consume, the alimentary Juices; among which there is also a very great Difference with respect to themselves and to each other. The *animal* ¹¹ Functions are those by which the human Understanding conceives Ideas agreeable to the corporeal Action with which they are united, or in which the Will is concerned, either by exciting the Actions themselves, or in being affected by the Actions when produced; such are the Sense of Feeling, Tasting, Smelling, Seeing, Hearing, *Perception* ¹², Imagination, Memory, Judgment, Reason, Passions of the Mind, and *voluntary* ¹³ Motions; in all which there are likewise many different Degrees. From a complex Idea then of all these Functions, we may understand physically what Life properly is, how long it may continue, in what it immediately consists, and what Actions it may want, and nevertheless continue a long Time: And from hence we also learn *Health* ¹⁴ to be that Faculty of the Body, in which all its Parts are duly enabled to perform their respective Offices with Perfection. And lastly, it appears that all the Effects proceeding from those Actions may be reduced to the determinate Motion of the Solids

lids and Fluids upon each other, and the Change by that means made in the Aliments.

¹ Hitherto we have been explaining the physiological Part of Medicine, by which we acquire a Knowledge of the Structure and Action of the several Parts of the Body, not with a mere philosophical or curious View, but as it lays the Foundation to our understanding and curing the Disorders which may happen to the Structure and Action of those several Parts.

² Every Action in the human Body consists in Motion, either generated or changed, which we suppose to be sufficiently explained, when we have demonstrated to our Senses the Existence of the physical Mode or Condition, which, taking Place in any Body, produces the Effect which we call the Action of that Body, and which Mode being removed, the Action is also abolished. But we may be said to know the Causes of any Action, when we understand the Existence of a Body, which cannot subsist, as such, without producing that Effect which we call its Action. These most simple Causes being conceived in the Mind, are to be no farther explained or understood than by the simple Ideas which they impress agreeable to their Mode of Existence.

³ The deeper we descend into the Knowledge of natural Bodies, the more simple do we find their Nature. The Actions performed in the human Body, all result from the solid or fluid Parts separately or conjunctly composing the same Body. The Fluids in the human Body act only by their Motion, by which they dilate the Vessels containing them; and the Vessels exert no other Action upon their contained Fluids than that of Resistance or Re-action common to all Bodies, by

which the Vessels endeavour to contract themselves to their smallest Dimensions, and resist Dilatation; and which Action is known either under the Denomination of Elasticity, or the Power of Attraction. This same Force or Endeavour of all the Parts in the same Body, to retain and enter more closely into their Contacts with each other, is an universal Principle of Nature, to be ascribed only to the Creator of the Universe, who has determined this as a Principle of uniting the Parts of Bodies: For the Parts of Matter do not cohere by any innate Force of their own; but having a separate Existence, it was necessary for the Creator to provide another Power by which they might cohere together and resist Dissolution. There is still another Power in all Bodies, by which they endeavour to approach towards the Center of the Earth. The first of these is called the Attraction of Cohesion, and the latter the Attraction of Gravitation. These Principles being allowed and applied to the human Body, one may easily understand, that the Arteries exert no other Action upon their contained Fluids than that of contracting themselves as small as possible, so as to press upon and urge forward the Fluids which they contain. This Action is indeed so simple, that Physicians can hardly refrain from supposing to themselves other Powers in the Solids besides this Contraction, by which the Humours are changed; and this only because they cannot conceive how one and so simple a Cause should produce so many and different Effects or Actions; but one who with Attention, and without Prejudice, considers Nature, will certainly find nothing more than this simple Cause.

³ * In a dead Body all the Actions resulting from the Circulation of the Blood cease, but yet this contractile Force of the Solids continues a long Time

Time even after Death; that is, the Arteries continue to contract themselves more after Death than during the Life of the Animal, and this is all their Action in a dead Body. For the elastic Force residing in all, even the smallest Vessels, is increased by Cold, and diminished by Heat; and the same may be also said with respect to the Humours, since the Blood is lighter as it is warmer, and heavier or more solid as it is colder, in which last Case its Elements attract each other more powerfully; whence it follows, that throughout the whole dead Body the constituent Particles, both of the Solids and Fluids, more closely attract and approximate each other.

⁴ The Functions or Faculties of the Parts are to be distinguished from their Actions, since the Faculty may remain for some Time without producing its Effect by acting. As for Instance: I can, for a While, hold my Breath; which Action I therefore remove, though the Faculty remains entire: The Faculty therefore is every Thing in the human Body which is required to the Performance of any Action; but the Action itself is Motion produced or changed either in the whole Body, or in some particular Part. Hence it is evident, that all the Functions of the human Body depend on a just Temperature of the solid Parts with respect to each other. Finally, these Terms, Functions and Faculties, are of a modern Date; for what we call Functions, are by *Celsus* termed *Actiones*, as being better *Latin*.

⁵ Some Functions are peculiar to the Male, and others to the Female; and, consequently, there are Diseases incident to Women, from whence the Males are exempted.

⁶ Such as are destined to the Formation of only one particular Humour, as the Gall-Bladder, &c.

⁷ Such, namely, as are subservient to all the Faculties; as the Action of the Heart, Lungs, and Arteries.

⁸ The vital Functions are those absolutely necessary to Life, and by the Removal of which Life itself is removed. All the Faculties are not of this Nature, since Life may remain even after several Actions of the Body are destroyed. The necessary Effects of these vital Functions, considered alone, we call absolute Life. A healthy Person is possessed of all those Functions which are practicable by the Fabric of the Parts, and yet he does not exercise all those Actions at one Instant; for if that was to happen, it would produce Disease. But even the greater Part of the several Faculties may be destroyed, and yet Life may be continued by the remaining of but a few. This is a Doctrine which has been formerly treated of with great Elegancy by the celebrated *Pitcairn*. Numerous are the Parts of the Body which have been observed by Physicians to be destroyed, Life yet remaining. Thus the whole Leg and Thigh, and both the Arms, have been sometimes amputated without any apparent Injury to the remaining Functions; and even after the Trunk only remains, a great Part of that may be destroyed by a Gangrene, or a Suppuration of the Muscles, and yet the Death of the Person will not be a necessary Consequence; for even after this a great Part of the Lungs may be consumed, and yet Life be continued. I myself remember a Child, who after a Pleurisy was not able to speak without being out of Breath; but upon opening the Body of this Child, after Death, with mine own Hands and Eyes, I found, that all which remained of the Lungs was no larger than a Walnut, the Thorax being full of Matter, and the Diaphragm pressed downward to a very
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great Degree into the Abdomen, whence the abdominal Viscera were almost shrunk up to nothing; yet did this Child continue living for a considerable Time with so small a Portion of the Lungs; Life being carried on, in this Case, almost entirely by Virtue of the Encephalon, which remained entire and unaffected to the last, though the Child was obliged to be retained in almost an erect Posture by Pillows.

° Life is said to remain as long as the Heart receives and expels the Blood by its muscular Force; and from hence it is, that an Answer may be given to the Question, Whether Life still remains? But the Heart cannot receive the Blood without contracting and dilating itself; for if the Heart be deprived of this Faculty, without regarding any of the rest, not only Disease, but Death itself, will inevitably take Place of Health: And therefore Life is a certain Affection of the Heart; namely, its Contraction and Dilatation. That the Heart may perform these two Actions, it ought to remain in its proper Place, and continue adhering with the large venous Sinuses and Auricles both of the right and left Side, since it is from these Fountains only that the Blood can arrive into the Ventricles of the Heart; and without the Blood, the Heart, being empty, must inevitably rest and cause Death. But, besides this, it is also necessary for the Heart to expel its Blood into the Arteries, namely, into the Aorta and pulmonary Artery; for if you intercept the Communication of the Heart with these Arteries by dividing them, the Blood will be extravasated into the Pericardium, and instant Death will follow. But to enable the Heart to expel its Blood into the Arteries, it is required for them to be sufficiently dilatable to receive the Blood expelled by the Force of

the Heart. But the Force of the Heart results from three Causes. 1. The Influx of the coronary Arteries with their Systole and Diaſtole. 2. The Action of the cardiac Nerves. 3. The Influx of the venal Blood into the Auricles and Ventricles of the Heart itſelf. All which Cauſes are therefore abſolutely neceſſary to Life. For the Action of the Heart conſiſts in its muſcular Force; but no Muſcle can act when deprived of the Influx of its arterial Blood: And therefore the Heart cannot exert its Action, unleſs the Blood be ſent into the Aorta and thro' the coronary Arteries of its Subſtance. Beſides this, no Muſcle can act when the free Courſe of its Nerves is interrupted; and therefore the Motion of the Heart requires a free Courſe or Flux of the Spirits from the Cerebellum to the Heart. But the Cerebellum itſelf cannot tranſmit any Juice by the Nerves to the Heart, without firſt receiving it from the Arteries, as is evident from the Experiment of tying the Arteries of the Encephalon; for when only one of the four Arteries leading into the Cerebellum is tied, the Animal becomes weak, or his Strength fails him; after tying the ſecond, he begins to breathe difficultly, with a Stertor; upon tying the third, he becomes apoplectic; and if a Ligature be made upon the fourth, he inſtantly expires. Life therefore requires a free Courſe of the arterial Blood to the Cerebellum, in a ſufficient Quantity to generate a due Proportion of Spirits to be diſtributed through the Nerves which ariſe from the Cerebellum, and which are particularly conveyed to the Heart itſelf. But the Cerebellum receives no Blood for the Separation of Spirits, but that which is derived from the left Ventricle of the Heart; and the left Ventricle of the Heart, which impels the Blood to the Cerebellum, has itſelf no Blood but what it receives

ceives from the Lungs; and again, the Lungs can supply no Blood to the left Ventricle without first receiving it from the right Ventricle. And from hence again it follows, that Life absolutely requires a free Course of the Blood from the right to the left Ventricle of the Heart through the Lungs. And again, this Course of the Blood cannot be free without the continual Motion of the Thorax, and Force of Respiration; whence it follows, that Respiration is also absolutely necessary to Life in the Adult. We have now taken a View of those Actions which are properly vital; and from thence it appears, that the most perfect Life, which may be called Health, is that State in which all these vital and other Functions are most freely and readily performed to maintain the Body in its present State. On the contrary, that Death is a Privation of all these vital Actions; and that Life, in the lowest Degree, is a State approaching nearest to Death. Nor ought it to be here objected, that Life has sometimes remained for a short Time, when the Heart has been quiescent, or taken out of the Animal, whether Man or Brute, as we are told happened in an *English* Criminal executed for Treason; who, having his Heart pulled out from his Breast while he was living, agreeable to the Laws of the Country, was said afterwards to open his Mouth and move his Lips. But these Motions might be produced by the Force of Cold, driving the Spirits into some of the Muscles.

¹⁰ By the natural Faculties we understand those which conduce to preserve or maintain the healthy human Body in its present State. For our Life cannot preserve itself, and much less can it preserve Health, which is the aggregate Sum of all the Actions of the Body; which Actions even de-

stroy the Fabric both of the solid and fluid Parts ; that is to say, Health destroys itself, unless assisted by those Faculties of the Body which continually repair such Parts as have been destroyed by the Actions of Life or Health. A healthy Person cannot continue so for the Space of twenty-four Hours without Food or Drink, but he will be indisposed ; and the more healthy or robust the Person, the less can he sustain Hunger and Thirst : Hence *Hippocrates* pronounces athletic or strong Bodies to be most inclined to Diseases when they have arrived to the utmost Pitch of their Strength. Hence appears the Necessity of other Faculties for the Restitution of those Parts which are destroyed and thrown out of the Body ; for this Restitution cannot be made by the vital Actions themselves. A healthy Person in the Space of twenty-four Hours takes in three Pounds of Aliment, and this is continued daily ; and yet at the Year's End the Weight of the Body is found the same, neither diminished nor increased. But this could not be, unless there was every Day as much discharged from the Body as taken in, and as much repaired or added as was destroyed. Our Bodies are made up of the Aliments with which we are nourished ; and it is a Proverb among the *Greeks*, *I shall not be the Person at the Year's End which I now am.* Our Nails and Hairs are perpetually renewed, and a Bone, when broke, is joined together again by our Aliments, duly prepared ; namely, that which we receive from our Food, Drink, and Air, from whence the whole Mass of our Bodies is made up. For it is restoring the lost Substance of our Bodies by the ingested Aliments, which are properly no Part of the Body itself, that we understand by the natural Faculty. The Term Nature with *Hippocrates* is intended to mean the human Body furnished

nished with all its physical Properties necessary to Health. The Office of these natural Functions is to receive, change, and distribute, the ingested Aliments, that they may assume a Nature agreeable to repair the several Parts, and enable them to perform their respective Actions; and therefore the natural Functions presuppose the vital: For if the Mouth of a fasting Person who has been drowned, be stuffed full of Aliments, he will not masticate nor swallow any Part, which are the first of these natural Actions. But when the vital Functions are in Being, the Aliments may be then digested, changed, and fill the Vessels, so as to be formed into the Nature of our own Body, capable of maintaining it in the present healthy State. Hitherto are referred those Actions denominated receptive, concoctive, or distributive, with the several Secretions, and the Application of the nutritious Matter. If now the Stomach and lacteal Passages, Lungs, Liver, and Heart, with the other Parts, are in a healthy State, as long as they continue so, they will be capable of maintaining Health; but so soon as one of them is deficient in its respective Office, Disease immediately follows: And there are as many natural Disorders as there are natural Functions, from the first Division of the Aliment in Mastication, to its greatest Attenuation and Discharge by insensible Perspiration.

" By the Mind we understand the cogitative Part of Man, which is itself changed by thinking, and likewise excites Changes by its Thoughts in the Body itself. The animal Faculties therefore comprehend all those Actions of the Body which excite a Change in the Mind by the Alteration made in the corporeal Organs themselves, as well as those Changes which are made in the Body, from an Al-

Alteration in the Thoughts or Ideas of the Mind itself. Hence then an animal Faculty is the Power of exercising any Action, which can either excite a Change in the Mind, or be itself changed by the Mind. The most exquisite Anatomist or Philosopher knows physically what Life is, though the Husbandman is ignorant of that Matter; but neither is the Anatomist any more sensible than this last of his own Life, carried on by the Action of the Cerebellum and Heart receiving and expelling the Blood. Therefore the vital Actions do not change the Thoughts or Ideas of the Mind; nor, on the other Hand, are those Actions dependant on, or determined by, the Mind: For the Heart continues to act, whether I am sleeping or waking. Nor are the Ideas of the Mind changed from the Exercise of the natural Faculties, by which the Aliments are formed into Chyle; nor are we at all sensible of the several Mixtures and Changes produced by this Action within ourselves. When I either shut my Eyes or open them in the most profound Darkness, I then see nothing, whether they are open or shut; but if a Wicket is opened but for a Moment, so as to admit the vivid Rays of Light to the Eye now open, my Thoughts or Ideas are then suddenly changed, that is, I see all the adjacent Objects: And therefore Sight is one of the animal Actions. Again, a Person who is at Rest does not in the least perceive the Actions of the Muscles of the Heart, Arteries, Intestines, or Lungs. But if now a Person inclines to remove his Arm from its present to some other Place, it is immediately performed by the Action of all the Muscles assigned to that Office; and therefore it follows, that this Motion belongs to the animal Actions, since it would never have happened without the Inclination of the Will. But animal Dis-

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orders are those arising from a Defect of the animal Actions: As, for Example, if the Brain and Eye be in a healthy State, but a Tumor arises suddenly in the Orbit so as to compress the Optic Nerve, this may occasion Blindness, which is an animal Disorder.

¹² Perception and the internal Senses arise from the external. Even when I reflect or think upon a Thing absent, it must always be allowed that the Thing was once present to the external Senses. When I recollect any Thing in my Memory, it always implies, that the same Thing was once presented to, and thought of, by myself. When I judge, I recollect two past Ideas, and compare them together; and therefore all these Actions of the internal Senses belong to the animal Actions.

¹³ Suppose a Clock to be present, which most accurately measures the minute Parts of Time; I then determine with myself, that after ten Minutes my Limbs shall be in this or that Posture; this is certainly a Foresight of the Thing not yet existing, which by my Will I fix to such a Time: After this looking at the Clock, and perceiving the Index is come to the determined Mark, the Motion which I willed is immediately executed; and therefore this Motion depends on the Determination of the Mind, and belongs to the animal Actions. But a Man may be incapable of these animal Actions, and yet live; for in a profound Apoplexy, Life continues, though all Sense and the voluntary Motions are suppressed: And even the natural Actions may be absent for a considerable Time without destroying the vital; as, for Example, we observe them absent some Time before Death in those afflicted with a pulmonary Consumption.

¹⁴ Health is that Condition of the human Body in which all its Parts are ready, and disposed for the Execution of the several Actions required from them. This is the most perfect and actual Life, in which many Actions either are, or may be, performed; but the common End of all Actions in Health is twofold, for they either tend to assimilate or prepare the Humours, or produce certain Motions.

§. 696. Any State of the living Body, which impairs or destroys the Faculty of exercising any of these Functions (§. 695.), is called a *Disease*¹; the Essence or Idea of which Disease is therefore the *Absence*² of what is required to render the Exercise of the Action possible, or the Presence of that which impairs or opposes the Exercise thereof. I do not take Notice of the Mind in this Definition, because the same State of the *Body*³ inseparably accompanies the determinate State of the Mind, and because Physic *restores*⁴ the usual Conditions of the Mind, only by acting upon the Body: And lastly, because the altered State of the Mind is *unknown*⁵, and indicates neither good or bad with respect to Health, except by the corporeal Effect already manifest and known.

¹ Disease is rightly defined the Injury of some Function, whatever *Helmont* may say to the contrary, in Opposition to the Schools.

² The Performance of any Action requires the Presence of certain Conditions, any of which being absent, will impede the Action itself; or even tho' all
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the Conditions remain, no Action will follow if a new Impediment arises. Thus if an Artery be wounded, the Person may perish by a Loss of the Blood, which escapes thro' the Wound from every Part of the Body. Again, if the Tunica Cornea of the Eye is punctured, the aqueous Humour will be lost, and the Person will not be able to see any Thing; but by the next Day the aqueous Humour will be renewed, together with the Faculty of Seeing: Thus the aqueous Humour only being lost, the Person will be for a Time blind, tho' all the other Parts of the Organ remain entire. On the other Hand, if a healthy Person be held under Water but for Half a Quarter of an Hour, Life will be perfectly destroyed, without removing any of the Conditions necessary in the corporeal Organs for the Continuance of Life, only by suppressing their Actions by stopping the Respiration. Again, if a Person by a Fall from a high Place should extravasate some Blood within the Cranium, so as to compress the optic Nerve, he will be rendered blind, even though the Eye itself be perfectly sound. Hence we have two Classes of Diseases; as they arise either from an Impediment of the Function itself, or from the Absence of some necessary Condition; to which two Classes all Diseases may be reduced.

3 The Physician, so far as he cures Diseases, acts only upon the Body by changing, which he likewise makes a Change in the Mind; not because his Art is capable of affecting the Mind itself, but because, by an Appointment of the Creator, a determinate Action of the Body is always followed with determinate Thoughts or Actions of the Mind. The Surgeon who couches a Cataract, knows not what Sight is in the Mind; but by removing

moving the opaque Body which intercepted the Rays of Light, he renders the Eye pellucid, in Consequence of which the Eye, before blinded, will now see; nor does the Surgeon do any Thing more in this Case, than when we remove a Table, which intercepted the Sun's Rays. Thus therefore, barely by removing a corporeal Impediment, new Changes are made in the Mind; namely, the Ideas of visible Objects, which would not have been received if the Body had not suffered this Change; because a determinate State or Condition is inseparably connected with a definite Series of Ideas.

⁴ For Instance, the Physician is called to the Cure of a melancholy Patient; but he will be able to do nothing towards a Cure, if he uses the most persuasive Arguments, mathematical Diagrams, or other Artifices, which *Epicharmus* terms Purges of the Mind; but if the Physician, agreeable to his Art, discharges the atrabilious Humour, the Patient will be brought to his Senses in one Day's Time, only by the Change wrought in the Body.

⁵ It is not the Business of the Physician to be acquainted with what the Mind is, how it passes from one Thought to another, or how it recollects the past Ideas of Things, which we call Memory: For though all these Properties of the Mind are real, yet is the Knowledge of them of no Use to the Physician, so far as they have no Relation to the Body; for allowing him to be acquainted with all these Particulars, and supposing that he endeavours to correct the inconsistent Ideas of the Madman by the most authentic Reasoning, or even the mathematical Demonstration of *Archimedes*; yet, with all his Wisdom, he will be able to do nothing: But if he reduces the Humours to their healthy State, and restores the solid Parts to their respective Actions, the Mind will
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infallibly be restored to its right Way of thinking. If the Mind could forget the Faculty of Seeing, who could be able to teach the lost Sense? The Seat of an Apoplexy is not in the sensitive Mind, altho' this Disorder destroys the Functions of the Mind; even Blindness itself is no Defect or Incapacity of the Mind; for we have no Instance of a sound Eye, free from all Impediments, being incapable of Sight. *Paracelsus* seems to express himself better upon this Subject than many of the Schoolmen; for the Body, says he, is an House, and the Mind its Inhabitant; so that if any Thing is amiss, the House must be cleansed or reformed: Let the Windows of the House be clear, and the Inhabitant will see; that is to say, restore the Eye to its due State, and the Patient will, consequently, be able to see. Do not therefore ask me whether the Body, like a Clock, is sometimes absented by the Mind; for of this I am ignorant: But so long as we know that we have a Body, we may be certain it is inhabited by the Mind. These are natural Consequences from the Laws of Nature.

§. 697. Therefore the Nature of every Disease whatever is to be known and found in the various *Conditions* ¹ of the several Parts of the Body variously affected; which Conditions we have before observed, described, and explained. Nor is it of any Use to take into Consideration the *animating* ² Principle which has been drawn into Physic by some Men of Note, as will be apparent enough to every impartial Enquirer.

¹ The most perfect Knowledge in Physic consists in having an accurate Description of the human

man Body as full to Sense as possible, that the Physician may have the same Idea of the human Body as is agreeable to the Mode in which the Creator ordered it to exist, without reflecting upon the Manner how it came to be ordered so. This Knowledge may be therefore best attained by a minute Survey of the Nature of the solid and fluid Parts, and of the several Actions throughout the whole Body, with the Organs by which they are performed, and the physical Conditions or Circumstances upon which each Part has its Dependance, by which means a Knowledge will be obtained of the Causes of Action throughout each Organ: As for Instance, in the Heart we know that the Causes of its Actions are the Arteries, Nerves, and venal Blood; nor is there any other Part, besides these, whereby the Heart is connected to the rest of the Body. If therefore we patiently and truly remark the Actions assigned by the Creator to each Part, and observe what Circumstances or Conditions are necessary towards each Action, we then know every Thing that is either useful or possible, and shall have laid a true and firm Basis for the Practice of Physic. Again, no one knows what Sight is in the Mind; but we may be said to have explained Vision, when we have given such a Description of the Eye and its Action as is agreeable to the Fabric assigned to it by the Creator, including the physical Conditions or Circumstances under which the Action is performed, that is to say, the Nature of Light, Reflexion, and Refraction, &c. more than which we are not capable of knowing. For altho' a red Colour may be easily known or perceived without Fallacy or Obscurity, yet no one can determine the Cause why it appears red. But to restore lost Parts is what we can never learn; for no one can renew a Leg or Foot
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that has been amputated, tho' all the large Vessels remain in the Stump, from whence the Foot was nourished; nor can we so much as procure the Regeneration of a Hair or Nail which has been taken up by the Root.

7 They who endeavour to persuade us into the Notion of an Archeus, or cogitative Principle, ought first to demonstrate the Nature of that Being to our Senses, together with the Means by which it communicates with the Body.

§. 698. Whoever then has perfectly understood all the Conditions required towards each Action, will plainly perceive the Deficiencies of each Condition agreeable to the known Disease, and from thence he will well understand the Nature of the *Disease*¹, necessarily following from the known Defect; and this Knowledge is termed *Pathology*², or the Doctrine of Diseases, which is divided into several Parts, agreeable to §. 34.

¹ To know a Disease, is to know the Defect of the Function, whether it be from a present Impediment, or from the Absence of some Condition necessary to the Function; but to understand the Defects of any Function, we ought to be first provided with a Knowledge of all the Functions that can be exercised by any Part; and these can be only attained by a Knowledge of the Parts themselves, which are the Instruments productive of each Action, and of the physical Conditions under which they exert their Actions: And when these Causes of Action are known to us, the Action itself may be said to be understood. For one who is acquainted with the physical Cause, will be like-
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wife acquainted of the Effect, since they are immediately connected. For Instance; you have attained a Knowledge of a Thousand physical Causes, which are conjunctly necessary to render the Eye sound and fit for Vision; and in that Case you may be said to understand the whole Function of Sight: But when you know that one of these physical Conditions are absent, you understand that the Function cannot be performed, and that the Defect lies in the thousandth Condition, while the other 999 continue to operate after their known Manner. The Knowledge of a Disease therefore, depends upon a perfect Knowledge of the Actions whose Deficiency constitutes the Disease; for it is not barely sufficient to take up with the Name of a Disease, but its immediate Cause must be known. One may easily know that a Patient is blind, but that Knowledge will conduce nothing towards a Cure, without understanding the Cause from whence it immediately proceeds, whether the Defect be in the Humours in the Nerves, or in the external Parts. Again, there is a perfect Deafness in the right Ear of a Person, and the Patient asks what his Deafness is? The Answer is, a Loss of the Hearing; but this may proceed from a Defect in numerous Causes, in all which the Disorder is termed Deafness; so that the Disorder is, at the same Time, One and a Thousand. All the Kinds of Deafness together give the full Idea of that Disorder, without explaining any Thing, because there is no such Existence in Nature as a general Deafness, without resulting from particular Causes. But suppose the Kind of Deafness to be that arising from an Obstruction of the auditory Passage with a Pitch-like Matter, you will never be able to know or cure this Deafness without understanding what it is to hear, without which you will no more understand the Nature of the Disease, than

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that the Patient is deaf, or incapable of hearing; nor will you be capable of affording him any Assistance, without having first recollected the several Kinds of Deafness, and determined that which is present. But if you have a perfect Idea of all that relates to the Sense of Hearing, and foment the disordered Ear, afterwards injecting a Mixture of warm Water, Salt, and Honey; you will, by that means, discharge the Matter obstructing the Ear, so as to restore the Patient to his Hearing. But if, again, another receives a Blow on his Head, from whence some Blood is extravasated upon the Brain, where, by its Pressure, it renders the Person deaf; in that Case, no Fomentation or Injection by the Syringe will be of any Service, because this is a Deafness proceeding from an Oppression of the common Sensory: But if here you remove the efficient Cause, namely, the extravasated Blood, by trepanning the Skull; you cure the Patient. But, in this Case, all the Causes of Deafness are to be held in Memory, without which the most obvious Disorders cannot be cured; you may perhaps, indeed, happily cure the Patient by Accident, if his Case should fall under those Causes of Deafness with which you are acquainted; but the Event will be dark when the Disorder arises from Causes of which you are ignorant. From hence it is, that we have so many Patients unhappily treated; and from this Ignorance it is, that many Surgeons have injudiciously ordered Spiritus Salis Ammoniaci for a Gutta Serena. But if you have a full View of all the Causes concerned in Hearing, you cannot then fail of obtaining a just Idea of the Disorder which you are about to cure. Another Person, for Instance, has a Deafness come upon him suddenly, though he heard very distinctly but a little before; but, after a While, he is taken with a violent Ca-

tarrh, followed with a Diarrhæa, which terminates the Disease; and this happens when the Humours of the Catarrh have filled the Aperture of the *Eustachian* Tube, opening into the upper Part of the Fauces, in which Place the Membranes are tumefied, as they are in the Nostrils in a Cold; and such a Distension of the Membranes may occasion Deafness; but when the Humours attenuated take their Course downward, the Patient becomes free from his Disorder. I am the more particular in these Matters, because at this Day some Men of Note believe that our Art requires more than a Knowledge of the human Body; beyond which, for my own Part, I think the Bounds of Physic ought not to be extended. In order to cure a deaf Patient, I am not to teach him what Hearing is, but to dispose the Organs of Hearing as they were intended to be by the Creator, that from a determinate Condition of the corporeal Organs, determinate Ideas may be excited in the Mind.

² Pathology is a general Idea of Diseases, or such Changes as are made contrary to Nature, and consists of four Parts; the first of which defines Diseases in general, and is Pathology properly so called, as giving a simple Idea of the Being which we call Disease, namely, some Action of Life changed or injured; but if Life itself is removed, there is no Disease: For if a Sword be run through a dead Body, none of those Consequences follow, which we observe in the living Body from the Life there present. And therefore formerly *Paracelsus*, and since *Helmont*, have rightly pronounced all Diseases to take Place in Life. 2. The second Part of Pathology describes the Difference of Diseases, not by a subtle Distinction, but by making so many different Classes of Diseases as there are different Methods of Cure required, agreeable to the differ-

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rent Causes and Circumstances. And this is necessary, because the same Disease requires a different Treatment, and produces different Effects in divers Parts of the Body: Thus too great a Weakness of the Solids may cause a Tabes in the Lungs, a Diabetes, or bloody Urine in the Kidneys, an Apoplexy in the carotid Arteries, &c. But Disorders springing from the same Cause are to be treated in the same Manner; but if we were to enumerate all of them, there would be no End, since they are innumerable. 3. The third Part of Pathology considers the Causes of Diseases. 4. The fourth and last Part of Pathology considers the Effects following from the Disease as their Cause.



Of the different Kinds of Diseases.

§. 699. **A**S therefore the Actions or Functions of the Body, so may Diseases be distinguished or classed; and as Conditions are reduced to their respective Actions, so may be likewise their Defects: Hence then we have (1.) Diseases of the most *simple*¹, and of the *organical*² *solid*³ Parts. (2.) Diseases of the Humours with respect to their *Nature*⁴, *Quantity*⁵, and Qualities acquired by Accident. (3.) Diseases compounded of these two, such as are peculiar to Male or Female, or *common*⁶ to both. To these Classes all Diseases may be briefly reduced.

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¹ Namely, in a solid Part, so far as it agrees in common with the Nature of all the other solid Parts; these have been denominated, by the *Arabs*, similar Parts.

² Organical Parts are those compounded of several simple ones in such a Manner, that while each single Part produces its Action, there follows from thence an Action common to the Whole. All organic Diseases are therefore compound; for in a Weakness of the Lungs there is a Disorder of the simple Solids as well as of the whole Organ.

³ The Solids are such Parts as cohere together, so that they require a considerable Force to separate them; and the Whole, when at Liberty, rather yields to the Force, than suffers any Division of its Parts.

⁴ If we suppose the Solids to be healthy while the Fluids only are changed, it will produce Disease, from whence the Solids themselves will be injured; and, on the contrary, if the Humours are healthy, but are displaced or retained in improper Parts of the Solids, that will likewise produce Disease.

⁵ When the Quantity of the Humours is excessive, it is denominated a Plethora; but when their Qualities are vitiated, the Disorder is termed Caco-chymia; but when the Juices are deficient, it is called Inapition of the Vessels.

⁶ Namely, such as regard the Senses, external or internal, the Passions of the Mind, Motions of the Muscles, &c.



Of Similar DISEASES.

§. 700. **A** DISEASE, then, of the most *simple*¹ solid Part, called similar, is seated properly, 1. in the *minutest*² Fibre; which since it is a mere *earthy*³, slender, *simple*⁴, and *nervous*⁵ Body, or derived from the Nerves, and is composed of the most minute earthy Particles *connected*⁶ together with a certain Force by an intermediate, oily Glue, may be chiefly liable to the *Disorders*⁷ of too great Strength or Cohesion, too great Weakness, Rigidity, or Laxity, and a Solution of Continuity: But the four first of these Disorders have always a certain Proportion, with respect to the natural, healthy Habit or *Symmetry*⁸ of the Body itself, of which the Fibre is a Part; and hence arises a Difference in their Degrees; so that what is healthy in one, is often the Cause of Disease in another.

¹ Thus we call those Bodies whose Parts are all like each other, and like the Whole. But since organical Parts are composed of others more simple, it will be necessary for us to consider the Disorders of the simple and then of the organical Parts.

² The whole Body, however large in an Adult, grew up from a small Particle originally much more minute than the least Grain of Sand; and

yet in so small a Corpuscle were included Vessels and Humours, which were to undergo such a Change and Increase; but this Increase was not derived by an Apposition of Matter *ab extra*, but by the Humours formed within the Body itself. Even the Parts of the Body which now appear the most compact, were formerly in a liquid State, namely, before the elementary Particles concreted together into one Mass; but an elementary Particle of itself is neither an animal Solid nor Fluid, but when it is connected with other Elements, it is, by that Connection, made a Solid; and if it is mixed with other Elements without that Connection or Adhesion, it is then a Fluid.—Hence then the most simple Solid is one composed of two elementary Particles, which are equally disposed either to Fluidity or Solidity, but are now connected together longitudinally; for that Way the Cohesion of them will be less and more simple. Each elementary Particle itself admits of no actual Division either as to its Length or Breadth, but by an Apposition of others it admits of both Dimensions, and forms itself into a Line divisible according to its Length; namely, a least and most simple Fibre which has neither Breadth nor Thickness, with respect of being divisible into other Fibres, but has only Length, being composed of elementary Particles applied to each other in a Line. Such a Fibre indeed is known to us, but the elementary Particles, from whence it is composed, do not fall under our Senses, except in Composition. Such a simple Fibre, then, may be either rectilineal or circular.

³ That is neither capable of being dissolved either in Water, Air, or Fire; which may be said indeed of true Earth, but not of Salts.

⁴ Simple, as not being compounded of others like itself,

⁵ The

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⁵ The nervous Fluid, which causes the Growth of the least Fibres, must enter the least Vessels; but the least Vessels are nervous, and the Fibres do not grow but by an Apposition of elementary Particles from within; and therefore one of the least Fibres cannot be nourished but by the Nerves.

⁶ Particles which are merely earthy do not cohere, but fall asunder like Dust, and are blown away by the Wind; and therefore the solid Elements required a Glue to connect them together, which Glue is twofold, partly watery and partly fat or oily. When this Glue is destroyed, the Fibres dissolve into Dust or Ashes, their Parts no longer cohering together. For Example; to render the Thing more evident, I have some Ashes freed from their Salts by washing, and designed to make a Cuppel or Test, in order to which I therefore mix them with Water into a Paste, whereby they cohere together and make a Filtre. When I mix this same Ashes with the Oil and harden them in a Furnace, so as to force out the Oil, they then powerfully cohere together and make a very strong Vessel; but if the Fire is so violent as to expel all the Oil or Water entirely, your Vessel will then dissolve again into Ashes. Thus likewise the drying Action of the Air, being continued, dissolves earthy Bodies into a white volatile Dust, capable of being suspended in the Air like a Cloud; but after a Shower of Rain this same Earth coheres together into a thick Mud, which clogs the Wheels of Carriages.

⁷ A simple elementary Particle, considered in itself, suffers no Disease, at least none that we know of, since they do not fall under our Senses; nor do two or more elementary Particles admit of any other Disease than what regards their Connection. But their Connection may be either too strong or
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too weak, or none at all. From the first Condition arises Firmness, Elasticity, and too great Strength; from the latter proceeds Weakness, Laxity, and a want of Elasticity in the Fibres; and from the last proceeds a Solution of Continuity, that is to say, a Wound, when a Fibre dissolves into the elementary Particles which were before joined together.

^s I cannot here assign any general Rule how great the Degree of Cohesion ought to be to render it the best and most agreeable to Health; for as the Bodies of People differ, so does likewise the Cohesion of the Parts of their Fibres. When we were less than a Grain of Sand, we were a small liquid Drop. Before *Malpighi* had learned the Art of discovering the Progress of the Animal in Ovo, upon inspecting a prolific Egg in warm Water, the incipient Chick being placed upon a Feather, dissolved into a Liquor; but from such a State does the Cock grow up, whose Bones and Beak are so hard, that they resist being broke by the Teeth: It is not therefore in the Power of the Physician to determine, measure, or proportion, suitable to the Nature of Things. Lap-dogs, which are so much beloved by the Ladies, especially Virgins, brought out of *Spain* or *Portugal*, are generally esteemed the most beautiful when they are the smallest; and therefore they wash them daily with Alcohol Vini, by the Efficacy of which the solid Parts are so much indurated, that they admit of no farther Growth, and the Dog remains a Puppy all his Life. If, by any Art, the solid Fibres of a Child a Year old could be rendered as strong as those of an Adult, then the Heart would meet with such a Resistance from the Arteries as it could not overcome; whence we should have a little Man, no larger than when he was first born.

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born. From this Resistance it is evident, how injurious too great a Rigidity of the Fibres may prove; but nothing is more offensive than too great a Laxity. The Hydrocephalus is a kind of Laxity in the Membranes which connect the Bones of the Skull to each other, so as to permit them to be dilated by the Force of the Arteries; and in this Disease the Head enlarges to an immense Bulk; though it might be avoided or prevented, if we could render the Bones and Membranes firm enough to resist this Extension.

§. 701. The same Disease of a most simple Fibre, with its different Kinds (§. 700.), takes Place, 2dly, likewise, in the smallest *Membranes*¹ composed of those least Fibres joined to each other, or interwove together; 3dly, in the smallest nervous *Vessels*², formed by a cylindrical Concretion of such Membranes; 4thly, in the Membranes *made up*³ by such small Vessels interwove, instead of Fibres; 5thly, in the larger Vessels or Canals *composed*⁴ of these vascular Membranes, as we observe in all the larger Vessels of the Body, differing in Degree of Composition; 6thly, in those solid Parts which are composed of Vessels which have been deprived of their distending Humours, *compressed*⁵ and concreted together; or in which the *Humours*⁶ thickening and concreting together with the Sides of their own proper contending Vessels, form, as it were, *one particular Kind*⁷ of Solid: For if we examine the Disorders happening to all these Parts separately, we shall find them to be as before described.

1 In Geometry a Surface is said to be a Space without Thickness, the outside Appearance of a Body which has Length and Breadth without Thickness: In the same Manner, in the human Body, we call the simple Membrane one which has Length and Breadth without Thickness. For as the elementary Particles resemble geometrical Points, they are therefore without Dimensions; and as several Points make a Line, which has Length without Breadth or Thickness; so the elementary Particles compose a simple Fibre divisible only according to its Length. So here again, when several of these Fibres are applied by the Sides of each other according to their Length, they compose a simple Membrane, which resembles the Surface of Geometricians, such a Membrane being only divisible according to the Length of its Fibres running parallel to each other; though sometimes these Fibres ride over each other like the Threads of a Piece of Cloth, as *Malpighi* and *Glisson* have observed, the former in Plants, and the latter in Animals. But there are no simple Fibres or simple Membranes to be found in the human Body, but what are convoluted into the smallest Vessels; and therefore a simple Membrane forming such Vessels, is liable to no other Disease than of the Fibres placed by the Sides of each other, namely, too great or too little Cohesion, or none at all; and therefore the simple Membranes suffer the like Diseases with the simple Fibres.

2 We give the Name of a Canal or Vessel to a simple Membrane, when it is convoluted cylindrically so as to intercept a Cavity. The Disorders of such a Canal, as far as relate to its constituent solid Parts, are the same with those of a Membrane, namely, Rigidity, Laxity, or Solution of Continuity. But in this Part we have again another

ther Kind of Diseases, to define which we are to add the Consideration of a Fluid; and these are too great a Dilatation or Contraction of the Diameter or Capacity of the Vessel, of which we shall speak hereafter.

³ Simple Canals or Vessels may be considered as Fibres, since, like them, they are interwove and formed into other more compound Membranes; so that in these likewise the Disorders of the most simple Fibres will be assembled.

⁴ When again other larger Vessels are composed of the vascular Membranes before mentioned convoluted and conjoined together, those Vessels are liable to other Disorders, besides the Disorders of their Fibres. Of this Nature are all the Vessels hitherto known to us; for even the Vessels of the second Order are not large enough to be seen by the Eye, though assisted with the best Microscope, by which we are enabled to discern only the fifth or sixth Order: The Aorta has its Sides composed perhaps of several Thousands of Vessels and Membranes, which are each less complex than itself; and yet does this great Artery suffer no other Diseases than those of the simple Fibres.

⁵ Vessels which were formerly filled with some Liquor, becoming now empty, have their Sides pressed together, so as to bring their component Fibres into mutual Contact; whereupon they concreate into new Fibres. It is a common Property throughout the human Body, for no Vessel to continue any Time empty, without having its Sides grow together. If a Person is wounded with a Knife through the Peritonæum, a Cicatrix will be certainly formed in the Place of the Wound; but a Cicatrix does not transpire any Moisture, and therefore the Intestines or Omentum will grow or adhere to the Peritonæum in that Part. In the
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same Manner if a Wound penetrates the Thorax, and a Cicatrix is formed in the Pleura, for want of the perspirable Moisture the Lungs will adhere to the Pleura and that Part. When the like Causes obtain in every Point of any of the smallest Vessels, that is, if they are not separated by an intervening Fluid, they still much more readily concrete together, so as to form one solid Fibre out of many of the smallest Vessels. In this Manner are the smallest Vessels continually changed into more solid and compact Fibres, as the Animal advances from the Birth; which Fibres are themselves liable to the same Disorders with the more simple ones. The Heart has been found adhering to the Pericardium, the Parts having been first rendered dry by an Inflammation preceding the Concretion; and in the same Manner also we frequently observe the Lungs adhering to the Pleura from the like Cause.

⁶ It is the Nature of all the animal Juices to thicken and concrete by too long standing still; and from hence we have the Formation of a Polypus. When the Humours are in this Manner once concreted, they continually become more compact, and expel their more fluid Particles, leaving only an irresolvable Mass behind, which conjoin the Sides of the Vessel together, converts the same into an impervious Solid. These concreted Polypi arise first in the Middle of a Fluid like a Thread, and yet do they often extend themselves so as to cohere with the Sides of the containing Vessels. We have seen a hard Polypus in the right Ventricle of the Heart obstructing the Course of the Blood, and adhering so firmly to the Sides, that it could not be separated without the Assistance of the Knife.

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7 At first the whole Mass of our Bodies consisted of mere Vessels and Humours; but as we grow, many of those smaller Vessels concrete into one large one. The common Cavity of a Vessel thus compounded, exerts a more powerful Action than that of the component Vessels themselves. For all Motion in the human Body is derived from the Heart through the Arteries, whence the Impetus from the Aorta into the Cavity of such an Artery will be greater. The Artery in its Systole expels the contained Fluid, and fills the Vessels which constitute its own Membranes; but when the Force of the Heart dilates the Artery, then the Membranes and Vessels of its Sides are compressed. Whether or no there are other Ways still remaining, by which the Solids are composed from the Fluids, I do not here determine; but yet I find no other Instances by which the Vessels or Humours degenerate into solid Parts, taken Notice of by any of the Writers of Observations, to whom I pay a greater Regard than to systematic Writers and Commentators. Finally, these Disorders are natural Consequences resulting from the Continuance of Life itself, by the Action of which alone the small Vessels themselves of the human Body are obliterated or stopped up; so that, by Degrees, the whole Machine is at length rendered unfit for Life, which thus destroys itself, and naturally infers Death.

§. 702. But in the several forementioned Parts that are once sound or healthy, Diseases may nevertheless happen with regard to their Structure, if the least solid nutritious Particles are vitiated or ill *applied*¹; and we know, indeed, that the Particles to be applied may be
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disordered in their Bulk, Figure, or Solidity. And again, according to the Manner of their Apposition only, there seems to result the same Diseases with those before described (§. 700.)

† A Body is perfectly in Health, when a due Symmetry or Equilibrium subsists between the solid and fluid Parts. But suppose now, in such a healthy Body, the nutritious Particles are from any Cause so changed, that they cannot supply the Place of those Particles which are abraded by the Actions of Life; in that Case the Body will immediately begin to change and incline to Disorders. Hence *Helmont* rightly observes, that when the Restitution of Parts is not perfectly the same, the Body degenerates, and has but a short Life to lead. But the Physician can neither know nor cure these Disorders, which regard the invisible nutritious Particles, which may offend either by their too great Solidity, or the Manner of their Application or Cohesion.

§. 703. Whoever enquires farther into the Origin of these similar Diseases, will run himself into the Faults of the Humours, or else he will fall upon some Subtlety or unknown Principle, neither demonstrable to the Senses, nor useful to the Physician; and therefore the similar Distempers of the *Temperature* ¹ of the Elements, and of the whole *Substance* ² of the Body, as they are termed in the Schools, can neither take Place here, nor be understood; but they are to be reduced, if possible, to the compound Disorders, which regard both Solids and Fluids.

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One Half of the Writers in Physic consider only the elementary and most general Diseases of the Body. The *Galenists* are taken up about their *Calidum innatum* and *Humidum radicale*; the Chemists are altogether employed in the Predominancy of their Salt and Oil, or Sulphur; when, in Reality, both of them feed us with Words without any Sense or Signification. If you peruse the large Work of *Argenterius*, you may be entertained with this Sort of Discourse, very ingeniously handled, even for six Months together; but, after all, I pray now, what have you read? Upon this Subject you may also read the great *Sennertus*, in his Chapter concerning the Elements, where you will find a Discourse, the Knowledge of which can be of no Use, unless, like Cobwebs finely spun, they may serve to dazzle and embarrass the Intellects of a Reader, whose Sight is not keen enough to see through them.

² The *Galenists* teach, that Diseases arise from four primary Qualities ; namely, Heat distinguished into four Degrees ; Cold distinguished into as many Degrees, with Moisture and Dryness considered in the same Manner ; but they cannot, with any Face of Truth, reduce all Disorders to these Classes. Thus, when a Viper has bit a Man, Death will certainly follow, though neither Heat, Cold, Drought, or Moisture, offend ; and therefore the Antients, observing these Disorders, nominated them Diseases of the whole Substance, because they could not rank them among any of their Qualities. But if the Schoolmen understand any Thing by these Terms, they might have said with *Hippocrates*, in an intelligible Manner, that which offends is either bitter or salt, &c. or at least they might have laid aside the *Platonic* Harmony of the Elements. In short, they seem to have under-

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stood nothing of the Matter ; but rather than seem ignorant, they were willing to supply us with empty Words.



Of Organical Diseases.

§. 704. **B**UT when any Part of the Body, compounded ¹ of those before enumerated (§. 700, and 701.), is like an *Instrument* ² capable of performing some Action by the Motion of the Humours, or of producing any other Effect by its Fabric, that Part may then be considered either in itself as a Solid, or with respect to its contained Humours : But if we respect only its Fabric as a Solid, then organical Diseases may be reduced to the four following Classes :

1. Those which injure the *Figure* ³ of the Part, either in its external or *internal* ⁴ Surface, with the Accidents of each, as to Roughness, Smoothness, *Straitness* ⁵, Crookedness, *Laxity* ⁶, Density, Hollowness, or Solidity ; which Disorders are comprehended under the Title of bad Conformation.

2. Diseases of Excess or Defect in *Number* ⁷.

3. Those of *Magnitude* ⁸ increased or diminished.

4. and lastly, In respect of Situation, *Connection* ⁹, or Motion excessive or deficient.

¹ Hitherto we have considered the Disorders of the least Vessels, namely, the Nerves; we therefore now pass to the more compound Organs, as the Lungs, which are made up of those smallest Vessels. But if I consider the Lungs separately as a solid Part, I shall so far only find it liable to the Disorders before ascribed to the Solids; but if I consider it with respect to the Humours flowing through the Vessels, there will from thence arise very different Affections.

² Namely, consisting of so many of these Parts, combined together, as are necessary to accomplish the Action of the Whole. Thus the Eye is an organical Part of the Body, by means of which we see; and in its Composition we discover Membranes and Humours, Nerves, Arteries and Veins; which Parts, constituting the Eye, are themselves composed of other subordinate, solid and fluid Parts. The Diseases of the simple Solids have been treated of before at §. 700.; but there still remain others, which we discover by a more strict Enquiry. The Tunica Cornea of the Eye is altogether pellucid; but if this is rendered opaque in any Part, it forms either a Pearl or a Star; or if broad, it is termed Onyx or Unguis; and these Disorders may be distinguished into many more Degrees. For the Membrane of the Cornea is made up of innumerable Strata or Lamellæ lying upon each other in a convex Position; and these I have separated and examined for whole Hours together by the Microscope, having first wounded the Cornea in its Surface with a very small Needle. If now any of these Strata, or their Humours stagnating, should concrete; or if the Vessels themselves should be closed up, an Opacity will follow, depriving the Eye of its Sight, and may be properly esteemed a Disease in the solid Parts, though arising from

the Fluids. Hence then there are other Diseases which invade organical Parts, by taking up their Seat in the constituent similar Parts, as before described; and there are others, again, which respect its Composition or Office.

³ That is, the Face or limiting Surface of any Body.

⁴ There is a great deal of Difference, according as the Vessels are injured either in the external or internal Surface of the Part; for the Consequences of a Wound in the Bladder, which injures only the Peritonæum and cellular Membrane, are very different from those of a Wound which penetrates into its Cavity, where the Urine is contained.

⁵ Such a strait Course has Nature given to the carotid and vertebral Arteries; whereas the coronary Arteries take a winding Course.

⁶ If our Lungs consisted of as tender Vessels in our adult State as in a Fœtus, or as when we were Children, their Texture would not be firm enough to retain the Blood, which would escape through them on all Sides.

⁷ As when there are six or but four Fingers upon one Hand, including the Thumb as one; and of this Kind we have many Instances. Thus also the Aorta may be divided, at its Origin, into two; and sometimes we read of two Gall-Bladders found in one Body: But these Alterations do not usually disturb Life.

⁸ All Parts of a healthy Body observe their just Symmetry or Proportion, which if exceeded by an Enlargement of any Part, that Part will produce some Action with respect to the whole Body, whose Perfection consists in a mutual Connection of each Part for the Welfare of the Whole. As, for Example, in the Muscles; if any one should become larger than its Antagonist, it will prevail
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over the Action of its Opposite, and destroy its Use.

⁹ Of this Kind there are many Disorders, upon which depend the Mobility and Immobility of the Parts.

§. 705. But the Surface or Figure of the Part before sound, but now injured, will consist either in a Change of the Connection of its component Parts, or in the Disorders of the Humours which there *offend*¹.

¹ From this Consideration, only, an infinite Number of Kinds of Diseases may be banished, as they are founded upon the ancient Doctrine. The Figure of a Fibre (if that may be said to have a Figure which comprehends no Space), is that of a right Line; but a Surface is composed of Fibres joined parallel to each other, or interwove together; and therefore a Surface admits of no other Properties than what we observe in the Fibres themselves. But if, for Example, the Figure of a Part is required to be smooth, in order to perform its Action, as the internal Surface of the Eye-lid; if that smooth Surface is made rough, that Change of Figure will render the Eye-lid, which is extremely sensible within, incapable of moving freely over the Globe of the Eye; and this is a Disease. If the same Thing happens to the internal Surface of an Artery, it will be an Impediment to the Circulation of the Blood. But these Disorders arise either from an Apposition of Matter increasing the solid Parts, which rarely happens; or else it arises from an Obstruction of the Vessels, and an Accumulation of the Humours; for a sound Artery cannot be injured but by Obstruction or Con-

tusion; and the Pearls or Scars of the Cornea before mentioned, arising from an Obstruction of the Vessels, makes it evident that that Disorder ought properly to be referred to the Head of Obstructions.

§. 706. But so far as the Surface forms a *Cavity*¹, so as to make a Passage, Sinus, or Receptacle, it may offend in *Number*²; whence sometimes Disorders happen from the Magnitude of a Cavity either too much increased or diminished.

¹ When a convoluted Membrane intercepts a Cavity, it is either a simple Meatus or Passage thro' which a Liquor continually flows; or else a Sinus, when a Vessel enlarges from a smaller to a greater Capacity, so as to move the Liquor forward more slowly, as the Canal is farther from its Origin; like as we observe in the Sinus of the Vena Portæ, with respect to the mesenteric Vein; or, lastly, so as to form a Receptacle in which some Liquor stagnates for a Time, as in the Gall-Bladder.

² It is no matter, with respect to us, whether an Artery is divided into two or three Branches; for Disorders seldom arise from that Quarter.

§. 707. If the natural Capacity of any Cavity is too much *increased*¹, or if a new Cavity is formed, a threefold Disorder ensues under the Denomination of *Anastomosis*², *Diapedesis*³, *Diæresis*⁴. In the first Disorder, the dilated Mouths of the Cavity let out the Humours which they should retain; In the second

cond Case, the constituent Parts of the Membranes are so contused or pulled asunder, as to form vacant Interstices, through which is evacuated what ought to be retained: In the third and last Case, there is a true Division or Solution of Continuity made betwixt the cohering Parts. Hence it is evident, that these Kinds of Diseases ought to be retained and distinguished, though they often *terminate* ⁵ in the last, sometimes cure themselves spontaneously, and may be very well *explained* ⁶ by Mechanics.

‘ All the Vessels which come out from the Heart are derived from the Aorta only, which has a determinate Diameter, when it is duly disposed, with respect to the Capacity of the Heart, and the conjunct Capacity of all the other Arteries. If now the Aorta is dilated into an Aneurism, so as to acquire twice its natural Diameter, this will cause a Palpitation of the Heart; for the Heart expelling its usual Quantity of Blood into a Canal twice as large as it ought to be, and consequently as weak again, the Blood will therefore move forward more slowly, and resist the Heart, since it flows through a conical converging Vessel. On the contrary, if an Artery becomes narrower than it ought to be by a cartilaginous Tumor or Induration, as is frequent in old Age, that will likewise occasion a Palpitation of the Heart; because the Artery too strongly resists Dilatation, so that the Heart is not strong enough to empty its Blood into the too rigid Arteries. Hence it is evident, that a determinate Diameter, or Capacity of the Vessels, is required to a healthy State of the Body,

dy, and that Health cannot be maintained by all Dimensions of the Vessels.

² These Names or Distinctions of Diseases are even made with the greatest Propriety. *Hippocrates* considers the whole human Body as perspirable from without inwards, and from within outwards. His Words import, that there are open Tubes passing from every internal Point of the Body to its Surface for the carrying off Humours; and, on the other Hand, that there are also Ducts or Tubes opening freely from every Point of the Surface of the Body, to convey any Humours from thence inward. Now by Anastomosis we understand a Dilatation of the natural Orifice of a Vessel by some Disease, by which means the Liquor, which used to be contained in that Vessel, now escapes. Now in a healthy State of the Body, Sweat is never discharged throughout the whole Extent of the Skin, but only an invisible Vapour, the Skin of a healthy Person never being moist; but when a Piece of polished Gold is applied at the Distance of about a Straw's Breadth from the Skin, in that Case the smooth Surface of the Metal will be obscured by the Vapour coming forth from the Skin, and condensed by the Coldness of the Metal. But when these exhaling Arteries are so far dilated, as to admit either Sweat or yellow Serum to pass through their Orifices, it forms that Disease which we call Anastomosis; namely, the Liquor which ought to be retained within the Capacity of the Canal, will then escape through the dilated Orifice of the exhaling Artery; and this Dilatation is sometimes extended so far, as not only to transmit the yellow Serum, but likewise the red Part of the Blood itself, as in the Man and Woman mentioned at §. 667. which Case is a greater Degree of Anastomosis. Most Physicians

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are indeed unacquainted with these Disorders, tho' their Ignorance is deservedly to be reprehended. There are some Women subject to a spitting of Blood every Month, though they do not from thence receive any Injury, nor fall into a Consumption, yet are they subject to this Disorder of Anastomosis, in those Arteries which come from the Bronchials, which are so far dilated as to transmit the Blood, which being now redundant and incapable of making its Way through those of the Uterus, takes another Course through less resisting Vessels. The Disorders we are now treating of, usually arise from a Plethora, and go off when the Plethora is removed; for so soon as Blood enough is discharged to diminish the dilating Force, the Orifices of the Vessels will then collapse, and cure the Disease. In this Manner does the Anastomosis or Opening of the uterine Vessels happen as often as a healthy Woman suffers her menstrual Discharge. But there are even Instances of the Vessels, which naturally exhale only a thin Vapour into the Cavities of the Body, being so dilated as to transmit the red Blood itself, from whence terrible Disorders have followed; as, for Example, when the Pericardium has been found containing grumous Blood.

³ Diapedesis is when, by a powerful Distension of any Vessel, its Membranes are so far dilated as to leave Pores or Openings betwixt the interwoven Fibres, composing the Sides of the Vessel, through which the contained Liquor may escape. In this Case the Vessel is not broke, but distracted by too great a Dilatation. Suppose the ten Fingers joined together compose a close Vessel, and that, after this, two Fingers are removed from their mutual Contacts, so that a Liquor may pass through that Interval; you will then have an Idea of Diapedesis.

pedesis. But so soon as the distending Liquor is discharged, the distending Force abates which removed the Fibres, whereupon they approach nearer together, and close up the Wound.

⁴ Diæresis is an absolute Division of a Vessel, as when a Vessel is burst by an internal Distention; but when the Vessel is divided or eat through by some corroding Humour, the Disorder is termed Diabrosis; which are Distinctions not without their Uses. Thus an Hæmoptoe sometimes proceeds from Anastomosis of the Vessels, and is then not dangerous, though it might be equally feared with the worst Kind of spitting of Blood by a Physician ignorant of these Differences. Another Kind of Hæmoptoe may arise also by Diapedesis, and in this Kind the Vessels may close themselves again, and recover the Patient; and, lastly, another Kind of Hæmoptoe may be formed by Diæresis, or a Division of the Vessels, as when a Man breaks a Vessel by violent calling out, &c. and even this Species is also curable; but when a florid and acrimonious Blood corrodes through the Arteries internally, it is then an Hæmoptoe by Diabrosis, incurable by all the Art of Physic.

⁵ When the Anastomosis has been large, and continued for a long Time uncured, it may, at length, degenerate into a Diæresis, or actual Division of the Vessels.

⁶ These are not fictitious Names without any Meaning, as many have persuaded themselves, believing the antient Physicians have loaded Physic more with useless Terms, than they have promoted it; but they are true Differences of Diseases which daily occur in Practice, and are of the greatest Use.

§. 708. A Vessel too much *enlarged* by too great a distending Force of the Humours, occasions Disorders offending in the Matter, which is to be sent through, separated by, or discharged from, the same Vessel.

While any Vessel continues sound, but some Humour is urged with too great a Force into its Cavity, it causes this Disease. It is an Axiom, that the Capacity of the Vessel is in a compound Ratio of the distending Force directly, and of the contractile Force inversely; for the distending Humours endeavour to dilate the Vessel, while, at the same Time, the solid Fibres and Membranes endeavour to contract it as much as possible: Therefore the Magnitude of a Vessel will depend on these two Causes, and be in Proportion not only to the Resistance and contractile Force of the Canal, but also with respect to the Impetus and Quantity of the distending Fluid within. When the distending Impetus is as large again, and the Vessel resists as much again as before, its Diameter will remain the same; and in all Changes of the Vessel, so long as its contractile Force remains equal to the distending Powers, so long will the Vessel continue at Rest; but when the distending Force only is increased, and not the contractile Power, then the Proportion is changed, and many Disorders follow. In a healthy Person, the Blood is in a determinate Quantity, and bears a certain Proportion to the Capacity of the Vessels, as the Largeness of the Vessels are proportionable to the Quantity of the Blood. But if the same Person exercises his Body by Running, so that the accelerated Blood moves twice as fast as before, in that Case the Diameter of the Vessels will be increased as large again; for
either

either they will be obliged to transmit twice the Quantity of Blood in the same Time, or else that Quantity must necessarily distend the Vessels. As for Example, while I am speaking, one Ounce passes through my Vessels in one Moment of Time, but a little while hence two Ounces passes through the same Vessels in the same Time; it is therefore evident, that in this Case the Vessels suffer twice the Action: Hence then a greater Distension of the Vessels changes the Celerity of the moving Fluid, whether that Distension arise from the increased Force, or the increased Quantity of the distending Fluid. A Man sits still quite pale and cold, but in a little Time he walks, and then runs a great Pace, and in running his whole Face and Skin look red; so that if you now view the Skin of his Face with a Microscope, you will now perceive it filled every where with red Blood Vessels, which before were pellucid and colourless. But in this Case there is not an Addition of one Drop made to the Quantity of Blood, nor are there new Vessels generated; but the small Vessels which were before contracted by the Cold, are now, by the increased Motion of the Muscles, more distended by the Impetus of the Blood, since, by increasing the distending Force of the Humours, the Diameters of the Vessels will be proportionably enlarged; so that Vessels which before transmitted only a pellucid or serous Liquor like Water, are now so far dilated as to admit the red Blood, which the Microscope demonstrates to be flowing into those Vessels. But when the same Man returns again to Rest, after his running, the Vessels contract themselves, and repel back the Blood which they receive into the larger Trunks next adjacent, and by that means the Redness, before acquired, now disappears. Thus the most acute Diseases only disturb the Proportion
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of the Diameters of the Vessels in the human Body; and thus in the most healthy Body lie concealed the Causes of all Diseases, which immediately invade us so soon as the Proportion of our Vessels is changed. This, however seemingly paradoxical, is most certainly true. The Plague is the severest of the most acute Diseases; but I have myself seen a perfect Pestilence excited in a healthy Man by running beyond his Strength, from whence he expired in a few Hours, only because the Orifices of all his smaller Vessels were so dilated, as to admit the red Blood; and from hence the whole Surface of the dead Body appeared full of red Spots.

§. 709. But of the Cavity of a Vessel diminished, there are five Species enumerated.

1. *Emphraxis*¹, or a stopping up of the Cavity by a *viscid*², *thick*³, *grumous*⁴, *inflammatory*⁵, *calculous*⁶ or *chalky*⁷, purulent or *adipose*⁸ Matter, filling up the Cavity itself of the Vessel.
2. *Stenochoria*⁹, or a streightning of the Capacity by some Tumor arising in the membranous Substance of the Vessel itself.
3. *Thlipsis*¹⁰, or a Compression of the moveable Sides of the Vessel from without inward, when some external Cause presses the Membranes of the Vessel close together, whence its Capacity is by Degrees lessened, and at length totally removed.
4. *Symphysis*¹¹, where the Sides of a Vessel entirely grow together into one, so as utterly to destroy the internal Capacity of the Vessel, whether this be produced by Thlipsis or Emphraxis.
5. To these add *Synizesis*¹², in which empty Vessels are said to collapse or fall together and lose their Cavity, as we may under-

understand in those Vessels which have been distended beyond their Tone by Diseases, and are afterwards suddenly evacuated too much, or reduced to that State which we call Inanition of the Vessels. To these we perhaps ought to add too great a Contraction of the Vessels, by an Excess of Force into their *orbicular*¹³ Fibres.

¹ This Term denotes a closing up of any Passage by foldering together its Sides, as it literally signifies the shutting up of a Gate by nailing together the Doors; but in Physic we use this Word to denote an Obstruction of the Vessel by some Matter within, incapable of passing through without changing any Thing in the Vessel itself. This Obstruction may happen, more especially in all converging conical Vessels, as also in other Canals, from whence an infinite Number of Disorders may follow. From hence has been observed a fatal Ischuria, ascribed to a Calculus wedged into the Urethra, whereas after Death a very different Cause has appeared, namely, grumous Blood extravasated into the Pelvis of the Kidney, and concreted into a polypous Mass so as to obstruct the Ureter.

² Viscous Matter is that whose Fluidity is not sufficient to render it pervious through the Vessels.

³ A Matter may be said to be thick or gross in respect to the Size of its Particles; and thus a single red Globule of Blood, considered with respect to a serous Vessel, may be thus denominated, as being incapable of pervading the same Vessel from its great Bulk.

⁴ Grumous Matter is that composed of several Particles of the Blood concreted together into one Mass, incapable of flowing through the Vessels.

' Inflammatory Matter may be of various Kinds ; as of the Blood Globules themselves dissolved by too violent a Motion, and changed from their spherical Figure to others of many Sides, in which consists the inflammatory Nature of the Blood. So long as the Eye is capable of distinguishing the Particles of that Fluid, or its several Humours, it discovers nothing but Globules of several Orders, with some small Spiculæ of Sea Salt, which never assume a globular Figure ; the other Particles of our Humours, whether red, yellow, pellucid, or oily, appear all of a globular Figure, so that they are not capable of touching each other but in single Points ; and we know that the Power of Cohesion in Bodies, is as the Contact of their Surface : As when two Bodies touch only in one Point, their Cohesion will be only in that Point ; but if the Surface in Contact be made ten Times larger, then the Cohesion will be likewise ten Times greater. Hence, therefore, when the Blood Globules change their spherical Figure for others of many Sides, or are pressed flat ; then the Globules, which before touched each other but in single Points, will be contiguous, perhaps, in a Thousand Points ; whence they will adhere to each other with a Thousand Times greater Force, by which they will not be able to pass through the Vessels. This is the Rationale of a most simple Inflammation, not accompanied with an Error of Place, which last may arise in the following Manner : Not all the Vessels in the human Body are adapted to convey red Blood, which is contained properly only in the larger or sanguiferous Vessels ; the next Vessels to these are pervaded only by yellow Serum, and the third Order of Vessels transmit only Lymph, while the remaining Series or Orders, of an unknown Number, convey more subtil and unknown Liquors,

quors, till they at last terminate in the very smallest or least Canals throughout the whole Body. Now the least of the largest Order of Vessels transmit only one red Globule at a Time, and in a healthy Body none of these smallest sanguiferous Vessels ought to have their Diameter less than that of a red Globule; while the lymphatic Vessels, which are less than the sanguiferous, never admit any of the red or yellow ferous Globules in a healthy State. So long as the respective Series of Vessels and Globules maintain a due Proportion, the Humours circulate freely and agreeably to the Laws of Health; but if any of the pellucid Vessels are so urged by violent Motion, that the red or yellow Globules enter into the lymphatic Vessels, this produces an Inflammation by an Error of Place, the Elements or constituent Particles of the Blood having mistaken their Course, and entered into other Vessels.

⁶ A Calculus we call a hard friable Substance, not dissolving in Water, found either in some natural or preternatural Cavity of the Body. These stony Concretions are found in all Parts of the Body, none excepted, and even in the Brain itself, though in a jocular Way of speaking we only say, those have a Stone in their Brain who are not right in their Senses; but, for my own Part, I have observed Stones in the Brain of a learned Friend of mine, though the principal Seats of Calculi are the Urinary and Gall Bladder.

⁷ A chalky or earthy Matter is that which, by a small Force, may be dissolved into Dust, and dispersed through Water as if it was a dissolved Salt, though after a few Moments Time it precipitates and hardens into a stony Consistence, as those well know who make Heads of Men with Plaster of *Paris*; and they take off the Impression of a
Face,

Face, by spreading this Plaster over the same, which afterwards hardens like a Stone. Of this Nature also is the tartarous Matter often to be found about the Teeth of those who are not over cleanly.

⁸ For every Thing fat or oily is viscous.

⁹ A Stenochoria, or Narrowness of the Vessels, is when their Membranes or small Vessels composing their Sides are enlarged, so as to diminish their internal Cavity. This we are taught by Anatomy, in opening the Bodies of those who have expired after obstinate and violent Headachs, where upon opening the Cranium a considerable Tumor has been found in the falciform Process of the Dura Mater, by which the Cavity of the longitudinal Sinus being diminished, the Return of the venal Blood from the Brain is obstructed, whence a Turgescence of the Veins, which by their Pressure excite various Symptoms. In other Cases an Ischuria has been observed, in which no Urine has been discharged, nor any Passage afforded for the Catheter into the Bladder; but after Death a Tumor has been found in the Neck of the Bladder, formed in the Sides, not in the Cavity, so as to exclude the Entrance or Discharge of any Thing. An Ischuria of the same Kind has been also observed by a Distension of the Substance of the Ureter, so as to close up its own Passage or Cavity.

¹⁰ Thlipfis is when some external Cause in the adjacent Parts compresses the flexible Sides of a Vessel, so as to cause it to concrete together. To remove such Accidents is the Business of almost one Half of Surgery; and this Subject has been well treated of by *Fallopious*. The celebrated *Harvey* gives an Instance of a Man, the Cause of whose Death was an Atheroma, which being seated at the Division of the iliacal Arteries, compressed them. In another Man a monstrous Tumor of

the Foot with a Gangrene of the whole Leg was found to proceed from an Atheroma compressing the large crural Vein. *Vesalius* gives an Example of Blindness, arising from a Tumor pressing upon the optic Nerves at their Union. Thus you see how necessary it is to be acquainted with the Cause of a Disorder; for no one living could cure this Blindness, without being acquainted with its Cause, from whence he might be directed to remove the Tumor by a Salivation.

¹¹ Symphysis is when the Sides of a Vessel grow together, either by Thlipsis or an external Pressure, by which the interposed Humour is expressed: But this may result from various Causes, which, acting by an external Pressure, discharge the interposed Humour, and reduce the Sides of the Vessel into close Contact with each other. I saw a Wound in the Lips of a Child, from whence they grew together in one Night, and were obliged to be afterwards separated by the Knife. Thus also when the Eye lids have been excoriated, they have grown together in the Space of one Night; and in like manner the Lungs are often observed adhering to the Pleura, and the Heart to the Pericardium.

¹² Synizesis, or a Concretion of the Sides of a Vessel by collapsing together, is when the Membranes of a Vessel are not removed from each other by a due Quantity of interposed Fluid, whence the Sides of the Vessel preternaturally collapse or fall together. There are indeed some of the Moderns who deny that they understand these Terms; but these Men seem to be too hasty in their Judgment, and ready to speak before they have considered. It is true, this Disorder cannot take Place in the Arteries, because the Animal must perish before these Vessels could be so far emptied as to collapse;

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collapse; but it is easy to conceive, that this Disorder may take Place in the smaller lateral Vessels. When a Person is afflicted with an Anasarca, in which the Panniculus Adiposus is distended with an extravasated serous Liquor, so as to render the Limbs ten Times larger in Appearance, than they were in a healthy Body; and, in the mean Time, all the internal Parts and their Vessels are almost entirely emptied of their Juices, and collapsed together. If now the Panniculus Adiposus of the Legs is wounded, either by burning, or the like, the Water collected, in an immense Quantity, within the Cells of this Membrane, will be discharged through the Wound, and the distended Membrane will collapse; while from the same Cause has been often observed a fatal Concretion of the abdominal Viscera. In this Disorder then there is too great a Distension, followed with an Inanition.

¹³ For by the Force of these orbicular Fibres the Vessels expel their Fluids, and may, from the same Cause, have their Sides concrete together.

§. 710. But in *Number* ' an organical Part seldom exceeds so as to offend and excite Disease, unless some Injury to the Function follows from thence; but from a Defect in Number, an organical Part frequently is disordered, so as to come properly under the Denomination of a Disease.

' A Function is seldom injured by Redundancy; which occasions rather a Deformity than a Disease; but if any Part is defective or absent, the Part where it is wanting will be less capable of its Function: As, for Example, a Hand with but three Fingers will be less fit for taking hold of any Thing,

but if there are five Fingers, it may act near as well as with four.

§. 711. But the Magnitude of an organical Part is frequently morbid, and offends either by Excess or Defect. Under the first are comprehended *Tumors*¹, *Hypersarcosēs*² or fleshy Excrescences, *Nodes*³, Tophes, and Exostoses; and to the latter may be generally referred a *Contraction*⁴ or Streightning of a Cavity about the narrow Ends, with a Dilatation in the Middle, which may be caused either by a *Caco-chymia* or an ill Disposition of the Humours, an *Ecchymosis*⁵ or Extravasation of them, and a Diæresis, or too great a Tenuity and Consumption of them. This last happens when the Magnitude required to the Action of a Part is *diminished*⁶, as in an *Inanition*⁷ of the Vessels, an *Atrophy*⁸, a *pulmonary Consumption*⁹, too great a Contraction of the Vessels from too strict a Habit of the Solids, *the Loss of a Part*¹⁰, &c.

¹ The Parts of animal Bodies were intended by the Creator to grow equably by a gradual Evolution of their smallest Parts; and for this Reason the Animal is at first suspended in a Fluid, which, like a Bath, equally presses all the Parts, that while the Fœtus grows in the Womb, the Humours expelled by the Heart into all Parts of the Body, may be equally distributed; for if the external Resistance is equal, and the internal Impulse the same, it follows, of Necessity, that all the Parts will be equally unfolded. Thus are our Bodies equally pressed on all Sides, as well by the fluid
Air

Air when we are born, as by the Liquors of the Uterus before the Birth. But even the smaller and least Parts of our Bodies are placed in Cavities, and supplied on all Sides with Liquors; which Cavities are the Venters of *Hippocrates*, which he pronounces to be full of Spirits or Vapours, as in the Head, Thorax, and Abdomen, betwixt the Dura and Pia Mater, betwixt the four Ventricles of the Brain, and all the Nerves.

The Ancients denominated every soft and red Part of the Body Flesh; but the Moderns have restrained this Term to the Muscles, assigning different Names to the other vascular Parts of the Body: Yet, from the Custom of the Ancients, the Term *Hyperfarcosis* or *Sarcoma* is used for any Tumor preternaturally increasing the red or vascular Parts of the Body, with an Injury of their Function. I have seen these Tumors generally seated in the Fat, interposed betwixt the other muscular Parts by an Enlargement of the Vessels, by which they have been rendered sanguiferous from a State of Pellucidity; but these Tumors are hardly ever found in the fibrous Flesh, at least I never could observe this, nor can I easily believe that it was ever observed by any one else. But the adipose Substance involves every Part of the human Body, and is furnished with numerous Vessels, which, being gradually enlarged, receive the red Blood; so that what before seemed to be Fat, has now the Appearance of red Flesh. Tumors of this Kind grow to an immense Bulk, and when they are uncovered by making an Incision through the Skin, the Tumor appears contained in a thin Skin, which may be freed on all Sides. Thus *Ruyfch* has observed one of them weighing eight Pounds, the Substance thereof being nothing but Oil or Fat. But hitherto we ought not to refer

an Aneurism of the Heart, though it is a Tumor of the fibrous Flesh, and is rightly demonstrated by *Lancissi* to be a Disorder much more frequent than is commonly supposed: For the other Muscles which have no Cavity do not seem capable of such an Enlargement like the Heart, which has large Vacuities within.

³ When only an Obstruction is formed in the Periosteum, a soft Tumor thence arises, which at first resembles a soft Paste, or the Horn of a new-born Animal; when this Tumor enlarges more and more, and rises up to a Point resisting the Touch, it is called a Tophe; and when it becomes still harder like the Bone itself, it is called an Exostosis. Sometimes indeed the Lamellæ of a Bone itself recede from their mutual Contact, so as to form a wonderful kind of Tumor; whence I have seen the Cranium three or four Times as thick as is usual in a natural State, the enlarged Part being spongy like a Pumice-stone; and when this Disorder continues a long Time, it turns to a Caries.

⁴ Sometimes the Cause of this Narrowness in the Cavity is an Extravasation, but this not often, the Disorder being generally seated in the Vessels themselves; when their Extremities being made narrower, they are enlarged in the Middle, and pressing upon each other, perhaps a Thousand of them are thus distended at one Time, so as to produce a large Tumor, though the Vessels themselves are extremely minute. I have even observed, what is almost incredible, that a lymphatic Vessel, which in a healthy State has been no larger than a Hair, has yet been distended into an Hydatide of a Pound Weight. A beautiful Woman came to consult me about a hard pale Tumor in her Neck, as large as a Man's Head: After examining the Tumor, I judged it to be only an Hydatide, and there-

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therefore sent for an expert Surgeon, whom I ordered to open it, whence was discharged a limpid Water, and the Tumor vanished; but I ordered some Pledgets to be inserted into its Cavity to induce a Suppuration, by which means the Sides of the Tumor being consumed, the Skin healed, and restored the Patient to her former Beauty. I once, in Company with *Ruyfch*, enucleated a large Tumor from the Back of a Porter, weighing eight Pounds, though the Cavity in which it was formed was, in a healthy State, no larger than a Mustard Seed. The Contents of this Tumor was a liquid Fat, or Oil.

⁵ An Ecchymosis is when the cellular Spaces betwixt the solid Parts are filled with extravasated Humours, which ought to be contained in the Vessels. The several Vessels destined to each Humour are not at Liberty, but tied down to the solid Parts by the cellular Membrane; for all Arteries run through the Middle of the cellular Membrane under the Surface of other Membranes, as well in the Pleura as the Peritonæum. This Membrane insinuates itself into every Part, and even betwixt the smallest Fibres themselves; insomuch, that we know not where its Extension ends: But being composed of such tender membranous Cells, that they may be easily distended and burst by a slight Inflation, it is therefore evident, that they will readily receive or give way to Humours extravasated; so that if they come from an Artery, a spurious Aneurism will be formed, or a spurious Varix when the Humours come from a Vein. But sometimes Humours are extravasated into the larger Cavities of the Body, into the four Ventricles of the Brain, the Pericardium, two Chambers of the Thorax, Peritonæum, vaginal Coverings of the Testicle, &c. for in all these Cavities, in a

X 4

healthy

healthy State, an aqueous Humour is continually exhaled, and again absorbed in the same Proportion. But if the Afflux of this Humour is too great, it causes an Hydrocephalus, or a Dropsy, in the Ventricles of the Brain, which produces a fatal Apoplexy; or else it causes a Dropsy of the Pericardium, whence surprising Palpitations of the Heart; or, lastly, it may cause a Dropsy of the Thorax, a true Ascites, or an Hydrocele; which last may likewise take Place in Women in the corresponding Parts.

⁶ By Defect, when the Magnitude of the Part is so far diminished, as to cause an Incapacity of it for performing its required Action.

⁷ Inanition of the Vessels is, properly, when their Fluids are so much exhausted, that their membranous Sides collapse together, from whence follow wonderful Disorders. A Woman big with Child is often happily delivered about the tenth Month; after which the Uterus being freed from its included Foetus, Waters, and Secundines, it then suffers a great Inanition of its Vessels, which now not being distended by nor resisting the Blood as before, that Humour escapes through them; and this Way may it continue to flow from the whole arterial System, until none of it is derived to the Brain and Cerebellum; whence an Apoplexy, Convulsion, Palsy, and often Death itself, happen in the Birth. These Disorders do not depend on the Nerves or Spirits, but the Cause before mentioned; and therefore they are attempted to be relieved by swathing the Abdomen, or by applying a Belt, as is common with the *European* Women. When *Hippocrates* speaks of Convulsions following from too great Evacuation, he understands an Evacuation continued even to Inanition, or a collapsing of the Vessels.

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⁸ An Atrophy is when a Part of the Body, by Degrees, falls away, because the Humours do not continue to distend its Vessels. The physical Cause of these Maladies is not known to many Physicians. If the whole Mass of Blood was to be changed into Water, Man would be an Animal living but a Day; nor would the Blood be retained in the sanguiferous Vessels by the Narrowness of the smaller Vessels, but it would escape on all Sides without at all returning to the Heart, until the Animal expired. In the same Manner, when the Humours are deprived of their proper Density or Consistence, in some Diseases they are dissipated in Sweats, whence follows a Consumption or a true Tabes. People under these Circumstances always find themselves in a Sweat, when they awake of a Morning; nor do they admit of a Cure, but continue wasting so long as they are disposed to these colliquative Sweats; which being once suppressed, the Humours become more dense, and the Patient begins to be nourished. But there is still another Kind of Atrophy, proceeding from a Loss of the Vessels themselves through which the nutritious Juices used to be conveyed.

⁹ A Phthisis, or pulmonary Consumption, is an Atrophy attended with a purulent Cacochymy of the Blood, from whatever Part the Matter be returned into the Blood, with which it mixes after being absorbed by the Veins; but if this Matter is returned from an Ulcer or Vomica in the Lungs, it is strictly a pulmonary Consumption.

¹⁰ Made by some external Violence; but when a Part is lost, its Office or Action must be so likewise.

§. 712. Lastly, there may be a Disorder of an organical Part, with respect to its Misconformation

formation with regard to other Parts; which may be either in its *Situation* ¹ and Connection, in which consists the Mobility or Immobility of a Part. To this Head of Diseases therefore belong the injured *Figure* ² of Parts to be connected to each other, too great a *Shortness* ³ of the connecting Ligaments, too great an *Elongation* ⁴, Laxity, Rigidity, or even a Rupture of them; the Absence or Depravity of some Matter or *Body* ⁵ necessary to be interposed betwixt those which are connected, or too great a Redundancy of that Matter; a *Distortion* ⁶, *Luxation* ⁷, or *Subluxation* ⁸; which three last Disorders may be either upward, downward, *forward* ⁹, backward, inward or outward, acquiring different Names to distinguish them and point them out to our Understanding. Add to these the various Kinds of *Herniæ* ¹⁰ or Ruptures distinguished from their Situation into *umbilical* ¹¹, inguinal, *crural* ¹², scrotal, or of the *Bladder* ¹³ in Men, or in Women, who are more liable to the crural Rupture; which are again distinguished, by their Contents, into those of the Omentum, Intestines, Fat, Air or Water; And, lastly, a Prolapsus of the Bladder, *Uterus* ¹⁴ or *Rectum* ¹⁵, a *Distortion* ¹⁶ of the Muscles or their Tendons from their proper Seats, a Dislocation or Rupture of the membranous Ligaments from their proper Seats, &c. are the principal Disorders belonging to this Class, and extremely necessary to be understood towards the Practice of Physic.

¹ There

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¹ There is no Part of the human Body but what is seated in its proper Place, from whence it cannot be dislocated without considerable Damage. An infinite Number of very different Parts are all assembled and conjoined together into the one human Body, connected and disposed in such a Manner, with regard to each other, as is most suitable to their respective Actions. We find the Teeth nowhere but in the Mouth, and the Nails nowhere but at the Ends of the Fingers; but if these are placed in some other Part of the Body, they constitute a Disease.

² When the Head of a Joint, or the receiving Cavity, changes its Figure, it forms an Anchylosis, or stiff Joint. The principal Articulation within the human Body is that of the Atlas with the Occiput, upon which the Flexion and Extension of the Head is performed. To this Articulation belong the two Apophyses or glenoide Protuberances of the Occiput, together with the two glenoide shallow Excavations of the Atlas, which receive the two Protuberances before mentioned; the Surfaces of both which are required to be covered with smooth Cartilages, and to be lubricated together with the Ligaments by the Liniment of *Havers*; to which add, finally, the Muscles producing the Motion. Since therefore, throughout the whole Body, such an infinite Number of Parts are required, it is no Wonder that we meet with so great a Variety of Disorders disturbing the Articulations. A Tumor may be formed in the Cartilage itself, so as to obstruct the moving Head of the Bone, and not to be discovered or cured by any Physician, who is not exquisitely skilled in the Anatomy of the Parts.

³ In the venereal Disease, a Stricture or Contraction of the Ligaments is sometimes observed in the

the Joints, destroying their Motion, which the *Dutch* call being stiff with the Pox.

⁴ When the Ligaments are elongated, the Heads of the Bones are too loosely retained in their Sockets; whence a Dislocation may easily follow, as we frequently experience in People of a weak Habit.

⁵ In every moveable Articulation, the Head of one Bone is received into the Cavity of another, and fastened by connecting Ligaments. These Ligaments generally spread round the Head of the Bone, and form a close Capsule without the least Aperture for any Humour to pass in or out; while, at the same Time, both the Head and Cavity of the articulated Bones are lined with a smooth Cartilage, to which Nature has added small Glands and Cells discharging a glutinous Mucilage into the Cavity of the Articulation, which is thus lubricated and defended on all Sides. This Mucilage is dissipated by Motion; but when it is absent, or inspissated, it occasions an Arthritis or Anchylosis: And even when it is separated agreeable to Nature, but becomes imperspirable or incapable of being absorbed by the bibulous Veins; then the Bones grow together, and produce the worst Disorders; or if it becomes acrimonious, it creates intolerable Pains in the Joint, and especially in the Thigh. These Particulars have been well handled by Dr. *Havers* in his *Osteologia Nova*.

⁶ A Distortion is when the Joint continues the same, but the rest of the Limb is altered from its natural Posture. This generally happens from the Muscles on one Side being stronger than on the other, by which the Bone is drawn from its proper Position. This often happens where several Bones are joined together, as in the Tarsus and
Carpus,

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Carpus, and in Bones connected Ginglymus, and sometimes even where they are joined by Enarthrosis, when the flexor Muscles are convulsed, and accompanied with a Palsy of the Extensors, whence may result a Contortion of the Limb, as in the Humerus.

⁷ Luxation is the displacing the Head of a Bone out of its Cavity, which in the simple Enarthrosis, where there is but one Head received into one Cavity, may happen in all Directions, upward, downward, forward, or backward; and in these Articulations this Disorder would more frequently happen, if Nature had not guarded against it by various Precautions. Thus, for Example, the Processus Acromion and Coracoides prevent the Os Humeri from being dislocated upward; and hence it is that Luxation so seldom happens in the wonderful Articulation of the Humerus with the Scapula; and Luxations happen still more seldom in the Articulation of the Humerus with the Cubitus. Finally, he will be capable of understanding and curing these Disorders, who is acquainted with and well remembers the Disposition of the Bones, Muscles, and Ligaments; by which he may understand the Consequences of a Luxation in each Joint from its Fabric.

⁸ A Subluxation is when the Head of one Bone slips out and hesitates upon the Margin of the Cavity in the other Bone; but this is seldom perfect: For if the Bone is not absolutely dislocated, its Head is easily drawn in again to its proper Cavity by the Action of the Muscles. But if it ever happens, it may in those Articulations which we call Ginglymus.

⁹ These Directions ought to be well remembered, since the Method of Reduction is to be various, according to the different Direction of the Luxation.

¹⁰ Thus

¹⁰ Thus we call a Dislocation of the soft Parts out of their containing Membranes; so that an Hernia is, as it were, a Luxation of a soft Part: But this Name is commonly restrained to those Herniæ which happen in the Peritonæum, which is commonly said to be broke, some of the soft Parts bursting through the Wound; whence it is evident, that the Term Rupture conveys a false Idea; whence there are few Surgeons who can give a steady Answer in these Matters. But the first who refuted this Notion was *Du Verney*; who has taught, that the Peritonæum is only dilated, and not broke; as, indeed, I never knew it was. There are three Places, in the Peritonæum, where it is not defended by the Muscles; two at the Groins, where in Men the spermatic Vessels pass through in a Bundle, and in Women are transmitted the Ligamenta Rotunda of the Uterus; the third Place is at the Navel. The Peritonæum lines the whole Cavity of the Abdomen on all Sides, and receives the Viscera into its Folds or Duplicatures; but at the Loins the Aorta and its Branches are placed under the Peritonæum; and therefore when the spermatic Vessels pass out through the abdominal Muscles, they do not perforate the Peritonæum, which is there only incumbent on them, and fastened to the Tendons of the Muscles thro' which the spermatic Vessels descend; but in this Place there is no Muscle to support the Peritonæum, only Fat and Vessels which afford little or no Resistance. Now when the Peritonæum is pressed outward by a more violent internal Force than is usual, it does not break, nor even dilate, except in these Parts where there is the least Resistance. When this Sacculus or Production of the Peritonæum reaches the Inguen, it is called a *Bubonocèle*; when it descends into the Scrotum, *Orchieocèle*.

cheocele. In the same Places in Women there are Blood Vessels ascend from the Thighs to the Uterus, as there are in Men descending to the Testicles; and therefore the Peritonæum may in these Places be distended in Women, as well as in Men. When there is a Tumor thus formed betwixt the Thigh and the Side of the Pudendum Muliebre, it forms a Bubonocoele; when the Tumor descends in the adjacent Part of the Thigh itself, it is called Hernia Cruralis; which has been sometimes known to descend even to the Knee, where the Tumor being opened by an imprudent Surgeon for an Abscess of the Thigh, the Intestine has been perforated, and discharged its contained Fæces. But in this Sacculus, formed by a Dilatation of the Peritonæum, there is nothing contained but what it receives from the Cavity of the Abdomen; namely, 1. an elastic Matter, whence the Disorder is denominated Pneumatocoele, or 2. the natural Moisture of the Abdomen, in the Form of a watery Liquor, which makes the first Species of the Hydrocoece, in which the Water is either capable of being returned into the Abdomen by lying down on the Back or not; 3. the Omentum prolapsed, whence the Disorder is denominated Epiplocoece; 4. the Intestines prolapsed, whence the Enterocoece. All these prolapsed Parts in a Hernia never touch the spermatic Vessels, but descend near them in a Sacculus while the Vessels themselves remain free, except from a Compressure by the hernial Tumor; for the spermatic Vessels take their Course through the cellular Membrane, which likewise encompasses the prolapsed Intestines. When this Disorder has been of long standing, the hernial Sacculus adheres to the adjacent Parts, and can never be returned. The Cure consists in preventing the Intestines from descending into the Sacculus; which is performed
by

by Compression long continued, whence the Membranes of the Sacculus grow together, so as to cure the Disorder radically.

" These Herniæ are produced in a different Manner from the former. At the Navel the Abdomen was formerly open when the Epidermis, Skin, Panniculus Adiposus, and Peritonæum, transmitted the Funiculus Umbilicalis through their Perforations; namely, two Arteries, a Vein, and the Urachus, folded together into a Chord. After the Birth, these four Vessels are cut asunder by the Midwife, when she delivers the Infant from the Mother; and the Vessels, being secured by Ligation, close up and form a Cicatrix, which continues during Life, under the Denomination of the Navel, from whence the umbilical Vessels descend on the outside of the Peritonæum, which in that Part is weak and undefended by Muscles, insomuch that there is oftentimes an Appearance of an Opening near the Navel. If now the Peritonæum is urged with a great Force in this weak Part, it may dilate and form a Rupture or Omphalocele; not because the Navel-string perforates the Cavity of the Peritonæum, for it lies on the Outside of that Membrane; but because the Peritonæum being there too strongly pressed, the Skin and Membrana Adiposa easily give way in the Part where they are perforated, and where they are never strictly conjoined together; and by this means the Peritonæum, though entire, is extended, by Degrees, under the Skin into a thin pellucid Sacculus, sometimes as large as a Child's Head, and, as I have seen, containing eight Pounds of Liquors. If such an Hernia is filled with an elastic Matter, it is termed Pneumatom-phalocele, in which the contained Air may be returned, or pressed back with a Noise into the Cavity of the Abdomen; 2. if it

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contains Water, that may be also returned, but not so easily; 3. if it is filled with the Omentum, it is termed *Epiplomphalocoele*; and, upon pressing the Tumor, we perceive an unequal Body within; 4. if it is filled with the Intestines, it is termed *Enteromphalocoele*, in which the peristaltic Motion may be perceived through the pellucid *Peritonæum*. These Ruptures generally happen to Women with Child, and, when recent, may be cured by pressing back the Tumor, and ordering the Patient to lie upon her Back in Bed. Yet does this Disorder frequently prove dangerous: For when the Intestine contains Air, Water, Chyle, or Fæces, it may be intercepted and compressed by the *Peritonæum*, so as to mortify. There is still another Kind of Hernia termed *Sarcocoele*, when the dilated *Peritonæum* thickens, grows hard, and assumes the Nature of Flesh; but it is not properly the *Peritonæum*, but the cellular Membrane without-side of it, and in which the spermatic Vessels run, which is so apt to be distended with Fat, and assume the Appearance of Flesh: For when this Fat is contused, or its Vessels broke, it forms an *Ecchymosis*, and has the Appearance of red Flesh. Even after a Vein of the Arm has been opened with a Lancet, if the Orifice of the Vein does not correspond to that of the Skin, the Blood is obstructed by the Fat, and, instead of escaping through the Wound of the Skin, spreads itself into the Cells of the adipose Membrane, and forms the Appearance of a Contusion or *Ecchymosis* under the Skin; in the same Manner, if a Vessel should be wounded in any other Part, the Blood, meeting with little or no Resistance, might escape and form a large Tumor. I once observed a large Tumor in the Scrotum of a fat Person, not from any Disorder in the Testicles

nor Prolapsus of the Intestine or Omentum, but from a mere Redundancy of Fat, which had made its Way through the Rings of the abdominal Muscles, so as to distend the cellular Membrane in the Scrotum, and form a Pimeloscœcele.

¹² By great Violence, but not often, Ruptures of the Peritonæum arise at the Distance of about four Fingers Breadth below the Navel, from whence they descend outward; for here there is a Semilunar Space, where some of the abdominal Muscles arise, and leave the subjacent Peritonæum naked. In this Place, by violent Straining, often arises a Tumor differing from all others, namely, a Distension of the Peritonæum, with the Descent of its contained Viscera. When the Abdomen is wounded in such a Manner that the Sword divides only the Skin and Muscles, without penetrating the thin Peritonæum, it may be then dilated by violent Inspirations, Coughing, &c. if the Wound be neglected, so as in a little Time to form a large hernial Sacculus or Tumor, filled, like the former, either with Air, Water, the Omentum or Intestines. If such a Tumor should fall under the Care of an unskilful Surgeon, he may treat it either by Compressure, or Incision, to the Destruction of the Patient; and even in a certain Merchant of this City of *Leyden*, we had an Instance of such a Tumor, which was proposed to be extirpated by some Surgeons of Note; which Affair made a great Noise.

¹³ This Kind of Hernia was first observed and described by *Ruyfch*, in his Chirurgical Observations; where he tells us of a Prolapsus of the Vagina together with the Bladder, so as to afford the Appearance of a Prolapsus Uteri; till at length, having opened the supposed Uterus, through the Importunities of the tortured Patient, it was found

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to be the Bladder, from whence he extracted a great Number of Stones, and afterwards cured the Patient. It is indeed much more difficult for the Bladder to prolapse in Men; yet there are some Instances of this; as may appear from the History given us by *Ruyfch*, of a large Tumor formed in the Perinæum and Scrotum, by violent straining in a Retention of the Urine from an Obstruction of the Urethra; nor did the Urine discharge itself by the Catheter when introduced, unless when the Patient compressed the Scrotum with his Hand; and again the Urine ceased to flow as soon as that Compressure was discontinued. The Bladder in the Male is placed under a Production of the Peritonæum, at no great Distance from the Groin, in which is the Seat of Ruptures. If now the Bladder is more than ordinarily full by retaining the Urine too long; and if, at the same Time, there is a Cavity or less Resistance to it in that Part where is the Seat of Ruptures; then, by straining to discharge the Urine, the over-distended Bladder dilates in that Part into a Sacculus without the Peritonæum, and descends in that Part where the feminal Vessels descend into that Sacculus where the Intestines usually prolapse: Nor is it difficult to understand, that the Bladder, being pressed on all Sides, will yield in that Part where only it is not resisted. This is one of the most miserable Disorders. I saw an unhappy Jew who neglecting to discharge his Urine at the Celebration of his Nuptials, it being a Point of Religion with them not to leave the Marriage Table; he nevertheless continued to drink, without regarding the Calls of Nature, till he brought upon himself a most terrible Disorder. He discharges his Urine but once in twenty-four Hours, and is invaded with Pains like those of a Woman in Labour,

three or four Hours before the Discharge ; for he runs about, sweats, and is in Agonies, struggling every Way, till at last, with the utmost straining, he discharges all the retained Urine, without making Water again within the Space of twenty-four Hours more. From these Symptoms it is manifest, that the Bladder in this Man had dilated and insinuated itself into some preternatural Cavity, where the Urine lodged itself out of the Power of the abdominal Muscles.

¹⁴ A Prolapsus Uteri is twofold. In the first Case it subsides without changing its Figure, and with the Os Tincæ closed ; so that, from a Relaxation of the Vagina and Ligaments of the Uterus, its Body descends into the Vagina, and, stopping under the Urethra, hinders the Evacuation of the Urine. Sometimes, again, the Os Tincæ of the Uterus comes as low as the Labia Pudendi ; and, at other Times, the whole Uterus is inverted. This Disorder frequently happens to Women soon after Delivery, from their walking about or straining too early, as is very common among the poor Country Women ; for then all the Parts below are lax, through which the Infant was lately delivered, and the Uterus may easily descend. The last Case is where the Uterus is inverted, most commonly from the Midwife's pulling the Placenta too violently, without sustaining the Uterus with one Hand ; for if the Chorion, in this Case, firmly adheres, the Uterus itself may be drawn down, together with the extracted Placenta : And if, in this Case, it should be immediately replaced ; it will, nevertheless, be in Danger of subsiding again. Women are frequently lost by this Disorder, and know not the Cause of their Death ; for when a Woman dies in Child-bed, the Cause of her Death is seldom enquired after, or at least is hardly ever understood, though

though it be not from any imaginary Malignity, but for the most Part results from some mechanical Cause. The Os Uteri, soon after transmitting the Head and Shoulders of the Infant, is very much dilated and relaxed; and if, in this Case, the Navel-string is violently drawn while the Placenta firmly adheres, the whole Uterus may be inverted, with its Fundus drawn through the Os Tincæ, so as to bring the Surface of the Chorion into Contact with the Air. But from this Cause Death usually follows in the Space of three Days Time, because the Circulation is suppressed in that Part contiguous with the Air, whence an Inflammation from the stagnating Blood, with a Gangrene and Mortification, followed with Convulsions, a Delirium, and Death itself. The only Remedy is, to replace this tender Viscus with warm Cloths as soon as it is elapsed, and to keep the Woman at Rest, till the Uterus and circumjacent Parts are fixed in their Situations. Add to this, that the Uterus may be moved out of its Place in various Directions, as hath been taught us at large by *Deventer*; for this Viscus is altogether so moveable, that it is rightly called, by *Democritus*, an Animal within an Animal. If now the Os Uteri in a Woman with Child is turned towards the Offa Pubis, as it does not correspond to the Vagina, the Woman cannot be delivered while it lies in that Position; or even when it inclines to either Side, or towards the Os Sacrum, the Infant cannot make its way, however violently pressed, but thrusts the Uterus outward like a Bag; and the Midwife, ignorant of the Case, in vain searches for the Os Tincæ. This is often the Cause of difficult and fatal Deliveries, according to the celebrated *Deventer*.

¹⁵ The Sphincter of the Anus is so disposed, that, by the Contraction of its fleshy Fibres, not a

Drop of Water or other Liquor injected can make its Escape; but when the gross and indurated Fæces of costive People are that way discharged, the Sphincter is relaxed, and the lower Part of the Rectum may then subside and be inverted, so as to expose the Inside of the Intestine to View, as we see in Horses discharging their Excrement: For those Animals discharge their Dung from an inverted Part of their Intestine. But sometimes a worse Disorder than this Inversion happens at the same Time, namely, a Palsy of the Sphincter, or at least too great a Relaxation, whence the Rectum continues to subside; and when some Part of it has descended below the Sphincter, that contracts and strangles the Intestine, whence Inflammation and terrible Disorders. The only Remedy in this Case is, to return the Intestine immediately after it has prolapsed; but if it has subsided some Time, it is to be first fomented before it is replaced. Sometimes again the Rectum is inverted after the Sphincter is relaxed; though this is a Disorder more seldom happening.

¹⁶ The Muscles frequently are distorted from their natural Situations, and occasion that Disorder which the Ancients call a Tetanos, but the Moderns, from an *Italian* Word, call it the Cramp; in which Case the contracted Muscle is as hard as a Piece of Wood. For when the Capsules of the Muscles are so lax, that they do not confine them in their proper Situations, a Muscle is then distorted and contracted by the least Change of the Equilibrium. But, besides this, the Tendons are usually placed in Grooves or Cavities formed in the Surface of the Bones, to render them the more secure; which Grooves are by *Eustachius* properly denominated Sinuses. If the Tendons are but the least displaced from thence, the Cramp immediately

ately follows, and tortures the Patient even sometimes to Death; or if it ceases a While, it soon returns. Mr. *Cowper*, who first understood this Disorder, gives us an Instance of it in the biceps Muscle of the Cubitus, one of whose Heads had slipped out from its Groove towards the back Part of the Arm; the unhappy Washer-woman, who met with this Accident in wringing wet Linen, suffered the most intense Pains, and could not bend her Arm, which was by other Surgeons supposed to be luxated, till Mr. *Cowper* reduced the Tendon into its proper Channel. The Tendons of the extensor Muscles of the Fingers are contained in their proper Cases, by which they are secured and directed, lest in their Action they should change their Figure to that of a right Line. If now these annular Ligaments which bind down the Tendons at the Wrist, are broke or over-strained, as sometimes happens in Porters, from lifting great Weights, the Tendons then start out, and do not perform their Office, until they are secured by an artificial Belt of Leather fastened round the Wrist. The same Disorder not unfrequently happens in the Muscles which move the Larynx, whence result wonderful Symptoms.

§. 713. But there is still another Disorder, common to the solid Parts, both simple and organic, which is termed a Solution of Continuity, barely when it happens in the most simple Parts or Fibres; but in a compound organical Part it is variously denominated, agreeable to the Nature of the Part itself, the Difference of the Cause, and the Manner of its Application. To this Head therefore be-

long *Wounds*¹, Chaps or Clefts, Punctures, *Contusions*², *Ulcers*³, *Corrosions*⁴, Lacerations, Ruptures, *Fractions*⁵, Fissures, *Exfoliations*⁶, Caries, *Spina Ventosa*⁷, &c.

¹ A Wound is a recent and bloody Solution of Continuity in a soft Part, by some hard or sharp Instrument, moved, pressed, or resisting against the Part. When the wounding Instrument is sharp, hard, and applied according to its Length, the Wound is termed a Cut; or a Fissure, when the wounding Instrument separates the Parts from each other: But when the Instrument is hard and sharp-pointed, and wounds a soft Part with its Point only at one Blow, it is called a Puncture, or Stab.

² Contusion is a Solution of Continuity in an organical Part, by some hard and obtuse Instrument, moved, pressed, or resisting against the Parts.

³ An Ulcer is an old Solution of Continuity in a soft Part, accompanied with an ill Condition of the Juices in the Part. If the Juices are mild, so as to form laudable Matter, the Ulcer is termed benign; but if acrimonious, it is called Ichor, if thin; but Sanies, or foul Matter, when more thick and virulent, &c.

⁴ Corrosion is a Solution of Continuity in a soft Part by some acrimonious Liquor, dissolving the solid Fibres in Contact; as a Laceration is a Solution of Continuity in a soft Part by too great a Distension of the Fibres.

⁵ A Fracture is a Solution of Continuity in a Bone; but if the Parts remain in Contact, and the Division runs according to the Length of a Bone, it is termed a Fissure.

⁶ An Exfoliation is the falling off or Separation of a diseased Lamella from the Bone itself.

⁷ A Caries is a Solution of Continuity in a hard Part, caused by the corroding Action of some acrimonious Matter dissolving the Lamellæ of the Bones; but if this Caries arises primarily from a Putrefaction of the Medulla, it is termed a Spina Ventosa.

So many different Diseases, which you may see distinguished into a Hundred Kinds by Authors, may nevertheless be commodiously reduced to these few Classes, which ought to be retained in the Physician's Head, that he may run them over in his Mind, and examine how many particular Diseases may arise from the Position, Figure, Magnitude, &c. in a solid Part. For unless the Mind has distinct Ideas of these general Principles, it may be liable to err in the Diagnosis, Prognosis, and Cure of more particular Diseases; but when these are well remembered, when a difficult Case offers, the Mind will represent to itself all the possible Disorders and Symptoms described by Writers, and related to the present Disorder. By this Comparison, then, the Mind may be directed to the proximate Cause. Surgeons would not so often scrape or cauterize a naked Bone, if they did not confound an Exfoliation with a Caries, and a Caries with a Spina Ventosa.



Of Diseases of the HUMOURS.

§. 714. **T**HAT the Distempers of the *Humours* ¹ may be rightly understood and digested into good Order, it is to be first observed, that their *necessary* ² Qualities are either universal, required in every Liquor, or peculiar only to those of the human Body; and then again we are to consider the particular Disposition of the Humours of this or that individual Person. The universal Properties of Fluids are, to have their Parts so minute, as to escape the naked Sense; and the Cohesion or Contact of their Parts so small, as to be separable by the least Force, together with such a Lubricity or Smoothness of their Surfaces, that they may not entangle with each other. But with respect to the Nature of the *human Fluids* ³, there are several other Conditions to be considered, and from whence indeed a great many Disorders arise.

¹ A Liquor has its Parts insensible, though the Mass or Assemblage of those Parts is visible enough, and cohere together so loosely, that Motion being pressed upon the one Part, separates it from the rest without any considerable Resistance. It is necessary for the Particles to be insensible, otherwise a Heap of Sand would be a Liquor; to which it indeed

deed very nearly approaches when it is ground very fine, like that used for Hour-glasses, for then it is almost a Fluid; and if the Particles of that Sand could be so far attenuated as to render them invisible, it might then be termed a Liquor: For it now runs like a Fluid in the Glass, only it has sensible Parts. Dissolve Gold in Aqua Regia, and it becomes a Liquor. Besides this, the Particles ought to recede easily from each other with a small Force; whereas, on the contrary, by pressing any Part of a Solid, the whole rather moves than suffers a Separation of the Part. When I press a Piece of Ice with my Finger, it changes its Place, and the Part pressed does not separate from the rest of the Ice; but if I melt the same Ice at the Fire, and thrust my Finger against the Surface, it will give way almost without Resistance: And therefore Ice is a Solid, but Water a Liquid. But in the human Body the Humours are apt to concrete, or turn into Solids; a Property by which they differ from other Liquors.

² As if the constituent Particles should become visible to the naked Eye; or if the Cohesion betwixt those Particles should be so great, as rather to suffer the whole Mass to be moved, than to separate from each other; for in this Manner may the elementary Particles concrete and form a Solid.

³ For thus we denominate those Humours which are assimilated from the Air and Aliments in the human Body, so as to form Part of ourselves. Now in these Humours there is a certain Degree of Density or Compactness, not only in the red Globules, but also in the serous ones; the Density of which being altered, the Liquors degenerate from their proper Nature, and produce Disease, not resulting from any common Property of Liquors

quors in general. Besides this, every individual Person has his Juices of a particular Habit; the Bile of one Person is not like that of another, any more than their Blood; and even in their Urine there is a manifest Difference to the Eye. From this different Proportion of the alimentary Particles, and their Manner of Connection, arises not only the different Constitutions in People, but likewise their Inclination to innumerable Disorders of various Kinds.

§. 715. But all these Disorders considered with respect to the Fluids themselves, may be easily reduced to their Quantity or Quality injured.

§. 716. But if the Fluids are considered as contained in particular Vessels, they may be then found to err both with respect to *Place*¹ and Proportion.

¹ Various Disorders arise by a *Metastasis*, or Translation of the Humours; and even healthy Juices lodged in sound, but improper Vessels, may be termed morbid, because they are altogether productive of Diseases. When red Blood is found in the serous Vessels, an Inflammation follows, which, for the most Part, arises only from this Error of Place, or straying of the red Blood from the first or sanguiferous into the second Order of Vessels.

§. 717. Such a Redundancy of good Juices as injures the Functions is called a *Plethora*¹, which may be conceived to arise from a plentiful Formation of good Chyle and Blood, accompanied with a smaller Expence or Waste
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of the exhaling Humours. Hence a Plethora is considered by Physicians either with respect to the Vessels or the Strength, that is to say, a Plethora *ad vasa* or *ad vires*.

By a Plethora we understand an Excess of good Juices injuring the Functions. When the chylicative and sanguificative Viscera are strong, while, at the same Time, the smaller Vessels are not disposed to duly attenuate the Humours, and render them perspirable; a Plethora is then generated. Thus it sometimes happens in War, that a Man loses both his Legs and Part of his Thighs: For by one third Part of the Body being removed, while the chylicative and sanguificative Viscera continue equally strong, from thence will arise a Plethora, for want of a proportionable Diminution in the prepared Chyle and Blood. This Plethora may be considered either as to the Vessels or the Strength. A Plethora *ad vasa* is when the Quantity of sound Juices distends the Vessels to so great a Degree that they do not exert their due Compressure or Reaction, as when they are distended to twice their natural Diameter; and this takes Place only in the larger chyliciferous and sanguiferous Vessels, which in the mean Time compress the other smaller Vessels. A Plethora *ad vires* is when the Quantity of Humours is so great, that the Force of the Heart is not sufficient to propel them forward, the Momentum of the Body to be moved being greater than the moving Power; whence the Humours must stagnate of Necessity. *Helmont*, opposing this Doctrine of the Schools, does not admit of a Plethora: For, says he, if the Humours are not vitiated, it is no Disease; and if the Quantity is such as to excite Disease, the Humours are at that Instant depraved. So that, according to him, Disease does
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not answer to the Definition of a Plethora, but belongs to the Head of Cacochymia, or ill Qualities of the Humours. But from hence it is plain, that *Helmont* did not understand *Hippocrates* in his Aphorism, where he says, that those are most in Danger in acute Diseases, who are in their full Strength. But it must be allowed, that the redundant Juices cannot long continue in the same State, nor can they improve or assume better Qualities; and therefore it follows, that they must degenerate, or cause worse Diseases. A plethoric Man will continue in Health as long as the redundant Blood discharges itself, either by the Nose, or hæmorrhoidal Vessels; but what should hinder that Blood from as easily bursting some small Vein in the Plexus Choroides, where it would extravasate into the Ventricles. To prevent such an Accident, *Hippocrates* goes on to advise, that, in such athletic or strong Men, the Bowels are to be relaxed, and the Vessels emptied, that the Body may fill again. *Hippocrates* then does not make Fulness a Disease, but the Cause of future Diseases, and that so immediately the Cause, that if you would cure the Disease, you must first, of Necessity, remove the Plethora.

§. 718. Such a Scarcity or *Want*¹ of healthy Humours as injures the Functions, does but seldom happen, except from some external Force or sudden Accident, when, at the same Time, there is also an ill Disposition or bad Temperature of the Humours.

¹ I believe this seldom happens but from Wounds of the Vessels, or from Abstinence, when the Body is not recruited with new Humours; whence follows a Cacochymia or ill Condition of
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the Juices. But we are not in this Place to treat of a Wound, because the Hæmorrhage implies a Solution of Continuity in the solid Parts, and therefore belongs to compound Diseases.

§. 719. Any Quality of the Humours which injures the Functions is called *Cacochymia*¹, or an ill State of the Juices, which may be considered as residing in the Fluids themselves, with respect to their constituent Parts; or else with respect to the whole Mass of the Fluids, considered as a Part concurring to make up the Body.

¹ A *Cacochymia* is a Depravation of the Blood from its natural State, whether the Defect be in its constituent Elements or Particles themselves, or in their Proportion and Mixture.

§. 720. If we consider the morbid Indisposition of all the Particles of the Humours, it will be found to consist either in their *Bulk*¹, increased or diminished, their Solidity being too *great*² or too little; or, lastly, to consist in the *Figure*³, Rigidity, Flexibility, Elasticity, or various Degree of Cohesion and Divisibility of the Particles.

¹ Namely, the whole Mass contained under a given Surface, which is said to be larger, when it occupies a greater Space.

² Every Particle may be too compact, or too porous and loose; and from both these Conditions may arise Disease.

³ The same Body may acquire new Powers, only by changing the Figure of its Surface. But all the
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Particles composing our animal Humours are changeable in this Respect; for if such Particles are introduced into our Juices, as are incapable of changing their Figure, they may be considered as a Poison, and may produce such Alterations in our Juices as are inconsistent with Health and productive of Diseases or Death. In a Word, a red Globule of the Blood will continue its Colour and healthy State, so long as it is capable of being resolved into six serous Globules, without being too rigid, or too easily divisible.

§. 721. The Particles of the Humours *increased* in Bulk, affords an Idea of their being impervious, whence an Emphraxis of the Vessels (§. 709.), and an Atrophy, Symphyfis, and Synizesis in the smaller Vessels (§. 709.).

When a Man is in perfect Health, and the Particles flowing through the Vessels are increased in Bulk, so as to become larger, or more extended in Surface than a certain Proportion, this produces an Imperviousness of them through the Vessels; for the Extremities or Mouths of the smaller Vessels ought only to admit such small Particles as may be capable of passing through their Anastomoses into the Veins: For if a Particle is admitted so large as to be incapable of passing through, it produces the Disease which we call Emphraxis, or an Obstruction of the Cavity of a Vessel; but when a Vessel of the first Order is obstructed, all the smaller lateral Vessels which arise below the Obstruction will be subject to an Atrophy, as not being capable of receiving any Supplies from the Heart; and since it is the Property of empty Vessels to collapse and concrete together, from thence will follow a Synizesis.

zefis (§. 709.). Hence therefore we may understand how a simple Obstruction in the first Order of Vessels may produce so many and various Disorders in different Parts, and in different Constitutions.

§. 722. The Particles of the Humours being too much *diminished* in Bulk, affords us an Idea of their being too apt to exhale and escape through the several Emunctories, whence a too great Inanition of the Vessels.

Some of the Moderns have exploded these Disorders of the Fluids; and the celebrated *Craanen* and *Beentekoe* have writ, that the animal Humours can never become too thin or subtil: But we know, that from the first Order of Vessels, namely, the sanguiferous Arteries and Veins, ought to be derived thinner Juices into the smaller Series of Vessels, to be afterwards returned again into the larger Vessels. But the first Class of Vessels, by which I understand the sanguiferous Arteries and Veins, with the Heart itself, are so much stronger than those of the second Class, as they convey a greater Quantity of Humours; and therefore if the Humours of the first Order, namely, the red Globules, were to be rendered so small, as to put on the Nature of Serum, they might pass through the second Class of Vessels, which being so much more dilatable than the first, as they are destined to thinner Humours, it would follow, that all the Humours would be expelled by the greater Contraction of the first Series of Vessels into those of the second, transmitting, in the mean Time, little or none of their contained Blood into the sanguiferous Veins, to return again to the Heart: And thus would it be also with respect to the other smaller

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Vessels;

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Vessels; whence we have a true Idea of the *Tabes Anglicanus*, or the hectic Fever and Atrophy, often called nervous, to which the *English* are very subject, the Nature and Treatment of which is very different from a purulent Consumption. For Example; you see a Man, of a fine delicate Habit, begin to waste away and wither, almost like a dead Flower, being every Morning subject to colliquative Sweats: What now is the Alteration made in this sound Person? There is, doubtless, a Deficiency in the Force by which the constituent Particles of the elementary Juices are compacted together; that is to say, a Weakness of the sanguificative Powers; whence the Blood, being too thin and poor, or composed of too small Particles, will cause the Patient to waste in Sweats: But if you can so incrassate the Blood, as to make it continue in the first Order of Vessels, the Patient will be cured. I therefore order such a Man to rub his Body well, for the Space of Half an Hour, every Morning and Evening; to feed upon Aliments affording a substantial Nourishment; to use the Exercise of Riding, &c. which, alone, will certainly conduce to a Cure, when the Case is not too far gone. From hence we may understand how prejudicial attenuating Medicines must be in this Disorder, which itself results from a too great Tenuity of the Humours. The principal Remedies here, are those which compact the Humours; such as riding on Horseback, &c. for so soon as there is a sufficient Quantity of red Globules remaining in the sanguiferous Vessels, the Body will no longer waste away from Inanition of the Vessels; for empty Vessels contract themselves, so as to be almost none in Appearance.

§. 723. Too great Compactness or *Density*¹ in the constituent Parts of the Humours arises from too great a Force (*Vis vitalis*) changing both the Solids and Fluids; and from this Force we may, at the same Time, understand a *Dilatation*², *Rupture*³, or Erosion in the solid Fibres and Vessels, with too great Attrition and *Attenuation*⁴ of the Fluids.

¹ By Density or Solidity we here understand the specific Gravity or Weight increased with respect to the Bulk and Weight of another Body. The specific Gravity of human Blood ought to be to that of Rain Water as 13 to 12; and therefore Blood sinks when it is mixed with Water. If now mercurial Globules, 14 Times heavier than Water, are mixed with the Blood in the Arteries, they will strike with a Force 13 Times greater than the other Globules. If from the same Gun you discharge small Spherules or Shot of Gold, Lead, Tin, Wood, and Cork, with the same Force of Powder; you will find, that the heaviest Shot will be thrown farthest from the Gun, while all the rest will be found nearer in Proportion as they are lighter: For the heavier the Body, the more does its received Motion endeavour to continue on in a right Line. In the present Case, then, the Heart may be compared to the Gun, from whence the more ponderous Particles of the Blood being propelled, will go on farther, and strike with a greater Momentum upon the other Particles both of the Solids and Fluids: Therefore whether the Particles of the Blood itself are rendered more dense, or whether they are mixed with those of Mercury, the Solids will suffer a greater Action from the more ponderous Globules, by

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which

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which the laxer Parts of the Blood will be broke and divided, &c.

² A Diarrhæa Cruenta has been observed from the Use of Mercury, when its Globules have so far dilated the Mouths of the Vessels, that they suffer the Blood itself to escape through their open Extremities. In others, again, the Blood starts from the Gums, &c.

³ Hence it is that inflammatory Blood, which is the most ponderous, so often produces red or purple Spots; namely, when the Blood is extravasated from broken Vessels under the Skin.

⁴ When a healthy Person uses Mercury, which continues a long Time in the Blood-Vessels, the whole Mass of Blood will be dissolved, and almost entirely discharged from the Mouth under the Appearance of an aqueous Liquor; insomuch that a Person who at first weighed 200 Pounds, will be reduced to 100. The same Thing will likewise happen in a proportionable Degree, when any other Remedy heavier than the Blood is mixed with the Mass of Humours, and from hence great Effects, good or bad, may follow in strong active Vessels.

§. 724. If we understand the Solidity of the Particles to be too much *diminished*, we shall from thence have an Inactivity, with an Inclination to speedy Rest and Cohesion both in the Solids and Fluids.

¹ In Men of a weak and infirm Habit, in Children, and especially in the female Sex in the Time of their Virginitv, the Vessels are filled and distended by the alimentary Juices to the Degree of a Plethora, the relaxed Vessels in the mean Time exerting no Reaction; so that from hence the alimentary

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mentary Juices form only a thin watery Blood; and when such Girls sit still, they find themselves easy enough; but so soon as they move, they are immediately out of Breath; because the Humours, being too thin, do not sufficiently press upon the Vessels, and the Vessels do not sufficiently react upon the Fluids: Hence the Chyle is not changed into Blood, but continues like Whey.

§. 725. The constituent Particles of the Humours may offend by their Figure, more especially when they recede from their *Sphericity*¹, and become *angular*² or sharp-pointed; for then, applying all their Motion by a small Point, they become pungent or *acrid*³. These Alterations of the Humours are various, but may be most commodiously reduced, 1. to that Kind of Acrimony which is merely mechanical, where the Particles continuing the same, only change their Figure into acute solid Angles; 2. to *saline*⁴ Acrimony, which in the animal Juices is chiefly either *muriatic*⁵, ammoniacal, acid, alkaline, fixed, volatile, simple, or complicated; 3. to oily Acrimony, that is to say, Oil attenuated into a Spirit, a Kind of *adust*⁶ Oil from too great Attrition, a saline or earthy Oil, or an acrid Oil, as it were composed of an adust, saline, and earthy Oil, together; 4. to *saponaceous*⁷ Acrimony, like what we observe in the animal and vegetable Poisons; 5. to an Acrimony compounded of the four preceding, or resulting from *acrid Substances*⁸ taken into the Body, or from the Vitriols of Metals.

¹ All our Aliments afford Juices composed of Globules. The Milk, Serum, and Fat, are made up of spherical Particles, which were before ramous, or composed of many Sides; nor is it absurd to conjecture that the primary constituent Particles or Elements are spherical, since that Figure obtains in the Particles of the Humours, as long as they can be traced by the Senses. When a Drop of Blood, lately taken from a Vein, is viewed by the Microscope upon a Piece of Glass, it appears to be composed partly of small Globules, and in Part of Salts, running betwixt them like long Spikes; and therefore Salts are the least alterable into a spherical from a pungent Figure, which they either retain for a long Time unaltered, as many of the medicinal Salts; or else they never change that Figure so as to become spherical, which denominates them poisonous.

² The same Matter will produce a very different Effect, according as its Shape is either spherical or angular. For, in the first Case, spherical Particles have the least Cohesion; but the more they recede from that Figure, the more do they cohere. Again, if I make a Bullet from a Drachm of melted Steel, I may be able to handle or swallow that; or even apply it to a Wound, without any consequent Injury; but if the same Steel, without any Diminution or Addition, is formed into a surgical Lancet; this, being pressed by the Hand, will certainly wound it; or, being swallowed, may wound the Vessels and Viscera, so as to cause a fatal Hæmorrhage: But the Steel is no more a Poison now than before, only it has taken up another Figure.

³ A Wedge penetrates more easily into any Body, in Proportion as it is of a more acute Angle, as I formerly demonstrated geometrically. If you
 fling

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fling a Book at a Person in such a Manner that its flat Side touches the Skin, then the Points of Contact, both in the Skin and in the Book, will be a Thousand, and the Force will be distributed into as many Parts; but if the same Book acts by one Corner or a single Point, the Force of the Stroke will be the same, only all summed up in a thousandth Part of the former; and therefore the Obstacle or Part struck, will receive a Thousand Times greater Force than in the first Case: And as it is certain that Bodies give way in Proportion to the Force impressed by any Ictus, therefore the small Vessels will be violently altered by the Stroke of a Book which comes with its Corner foremost, whence the Part struck will be probably wounded. But an acrimonious Body is dense and rigid, terminating in a sharp Point, and impressing its Motion upon other Bodies by a very few Points. The sharper the Angle, or the fewer the Points, by which its Force is exerted, the more does it injure the Body upon which it strikes. But, besides this, it must be also dense; for a hollow Instrument of Iron does not commit so great Injury of itself as if it was filled with Mercury: For, by this means, those skilled in managing the Lance know how greatly to increase the Force of the Percussion. But will it yet, though dense and sharp-pointed, not be acrid unless it be rigid, for there is a great deal of Difference betwixt the Effect of a small Steel Needle and another of Lead. Add to this, that it ought to terminate in an Edge or sharp Point; since an iron Sphere does not wound or injure. But all these Conditions, Sharpness of Figure, Weight, and Rigidity, are discovered in Salts by the Microscope.

* Salt is a Body composed of invisible Particles, soluble in Water, and affecting our Taste with a

particular Sensation of Saltness. But all Salts, whether native or factitious, are acrid; for you can apply no Salt to the Eye but it will excite Pain, which is a manifest Sign of Acrimony.

⁵ Such as Sal Gem, Sea or Fountain Salt dissolved in Water.

⁶ Oil is composed of Globules; but if the same is burnt, or too long fried in a Pan, it becomes acrimonious and caustic: For by intense Fire, or even only by long keeping, the most sweet Cream or Butter becomes so bitter, that it is intolerable. When Animals or their Parts are burnt, then this Oil ascends in the Form of Smoke, and is converted into Salts.

⁷ This Force in animal and vegetable Poisons is hardly to be explained, since they operate so wonderfully as suddenly to produce all Sorts of Changes. When a Man eats *Lepidium*, *Capsicum* or *Guinea* Pepper, who has not been accustomed to it, it inflames his Mouth like Fire; and if he swallows it, a Quinsy follows of a short Duration; or if taken into the Stomach in a large Quantity, it causes Pain and Vomiting; and yet do Earwigs feed upon this acrimonious Herb, without any sensible Injury. This Force is therefore not mechanical, but relative to the animal Organs and Humours, which makes me at a Loss to know what to say concerning them; but we call them saponaceous, because their Action proceeds neither from Salt nor Oil alone. In the Spirit of Scurvy-grass there is less Acrimony than in the Grass itself. But there are some of these acrimonious Substances extremely fatal, and whose Effects no one can discover (*à priori*) from their Composition. The Toad spews out a kind of frothy Liquor like Saliva, without any remarkable Smell or Taste; and yet this, being swallowed, causes Gripes, and even Death,

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Death. The *Cicuta Aquatica Gesneri* is of a Taste agreeable enough, and may please an ignorant Person, though it is in Reality a dreadful Poison, of which many Children have perished, being deceived by its mild Taste; but it is no sooner received into the Stomach, but it begins to excite dreadful griping Pains, followed with Convulsions, and even Death itself.

⁸ When these cannot be discharged by Convulsions, Vomiting, or Purging, or continue incapable of being changed into a spherical Figure by the Actions of the Viscera and Vessels, they are then Poisons. The Ancients have very well termed Aliment that which, being taken into the Body, is altered into the Body itself which changed it, if Nature was stronger than the Aliment; but a Medicine is that which, being taken into the Body, is changed by the Body, and at the same Time changes the Body itself: As, for Example, Half a Drachm of *Colocynthis*, being taken into the Body, is a kind of acrid Poison, producing a Dysentery, discharging a great Quantity of liquid Matter, and then Blood itself. A certain Quantity of this Poison may be taken by a strong Man, and his Body will be thereby altered; but then the *Colocynthis* will be so altered itself by the Actions of the Body, that after a few Hours Time it will have no more Effect. Unless Medicines were thus altered by the Body, an Emetic once taken would occasion perpetual Vomiting; but when the human Body is so weak as to be changed by the Medicine, and, on the other Hand, incapable of changing the Medicine; there follows what we call an *Hypercatharsis*. Lastly, a Poison is something acrid, incapable of being conquered by the *Vis Vitæ*, whence it continues to destroy the Vessels and dissolve the Humours, till the whole Machine is demolished.

Hence

Hence those modern Physicians are in the wrong, who are in all Cases so fond of Medicines prepared from Metals; for a prudent Physician regards not only the present Disease, but the future Life and Welfare of his Patient. It is certainly bad Practice to give Mercury, sometimes to the Quantity of eight Ounces, in small Doses, for removing Diseases which are otherwise curable. I do not indeed disown that there are some Diseases only curable by Mercury; but as that weakens our Solids, and corrupts the Texture of our Fluids, it ought not to be used where milder Remedies will suffice. It is no difficult Matter to convey into young and weak Bodies these strong metalline Preparations; but it will be much more difficult to say how they shall be again intirely freed or discharged from those Bodies.

§. 726. There is still another grievous and scarce curable Disorder of the Humours, when the component Particles are so *rigid* ¹ or inflexible that they cannot be subdued by the Force of the human Body, so as to be divided and formed into suitable Masses.

¹ Animals, and especially Man, feed upon various Kinds of Aliments, from all which are formed Juices whose Particles are, for the most Part, of a spherical Figure, and so the most incapable of offering any Injury to the tender Solids. For when a Circle touches a right Line, it forms therewith such an acute Angle, that no right Line can be introduced betwixt the Circle and the Tangent without dividing the Circle itself; and then the Angle formed by the Surface of the Sphere or Circle and the right Line, is, of all Angles, the most obtuse possible: But the penetrating Force of
Bodies

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Bodies we know is as the Acuteness of their Angles ; and therefore the Force impressed by a Sphere is the least possible, being sustained by the adjacent Points of the Circle itself ; but so soon as a Body degenerates from a Circle into one of many Sides, it may be then injurious.

§. 727. But the constituent Parts of the Humours being too easily alterable in their Figure, may be likewise the Cause of Disease : For their Surfaces being flattened, will increase their *Contacts*¹, and they will cohere together.

¹ This extremely useful Class of Diseases has been overlooked by the Generality of Physicians. The human Body is so admirably contrived, as to contain an infinite Number of Vessels of several Series or Orders, each smaller than the others ; and if there are an Hundred of these Orders, the first Class of Vessels first contain all the Humours, and prepare them before they are sent to all the other Ninety-nine smaller Series. Thus the first Class of Vessels will labour for the second, the second for the third, and all succeeding Orders, and the last will labour only for itself. The human Body therefore is not merely an hydraulic Machine, through which an uniform or homogeneous Liquor moves ; but the Humour contained in the first Order of Vessels must undergo successive Changes in all the other Orders, so that the Particles which were largest in the first Order of Vessels, may, by the Actions of Life continued for twenty-four Hours, be attenuated so as to pass into the Vessels of the second Order ; and from thence again into the third, and other successive Orders,
after

after a certain Time. In the first Order of Vessels the Humours differ but little from a Solid; for Blood drawn from a Vein concretes into a Cake, which may be transferred from one Vessel to another without spilling a Drop, answering, in all Respects, to the Character of a Solid: Whence it is evident, that its Fluidity was owing entirely to the mechanical Motion; of which being deprived, it immediately recovers the Consistence of a Solid so soon as the Motion and Attrition ceases. We have before demonstrated this Solidity of the Humours to be necessary, to prevent them from escaping into the smaller Vessels; yet ought their Cohesion not to be too great, but capable of being gradually overcome by the repeated Actions of the Vessels. Health therefore consists in such a Disposition of the grosser Humours, as will enable them to be gradually attenuated into thinner Humours, slowly, and not of a sudden; by which means there will be a sufficient Quantity retained in the first Order of Vessels to supply all the rest: But when the red Globules are too easily dissolvable, the Person is of an infirm Habit, and will never be healthy, unless the first Order of Vessels and Humours are strengthened by riding on Horseback, and other proper Remedies.

§. 728. There is also a remarkable Disorder of the Humours, consisting in too great an *Elasticity* of some of their Particles; from whence their whole Mass is too much altered or broke in its Texture upon the least Addition of Heat, or Increase of Motion compressing the Humours.

There are some People so altered by the Variation of the Seasons, that it is scarce credible even

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to one who actually sees the Alteration with his own Eyes. I have seen some People surprisingly swelled throughout their whole Body, by eating a few Currants or Cherries, which produced not only an Inflation of the Stomach and Intestines, but also a Turgescence of the Arms and Face, so as to render it probable that the Particles of the Juices in those People were too easily dilatable, and susceptible of a sudden Change. Hence the Instability of Health in some People. But what, I pray now, could be the Cause of such a sudden Alteration and Rarefaction of the Humours? We find Powers in the Course of Nature capable of generating Motions, of which no Mechanician would ever think, if he did not discover them by Experiment. Thus the Tartar of Rhenish Wine may be kept by itself at Rest for whole Years, or even Ages; but if, after letting it be thus at Rest an Hundred Years, you place it over a Fire, it will suddenly burst the Vessel in which it is contained with a great Noise. A Bee, for Example, stings the Finger of a Girl, or she pricks it with a Thorn, and in a few Minutes Time not only the Finger, but the whole Arm, becomes four Times as large as it was, from a Rarefaction of the Humours, without any Augmentation of the Solids.

§. 729. Again, too firm a *Cohesion*¹ of the Particles composing the several Orders of Globules in the Humours may be prejudicial, since this will hinder the Formation of the lesser Globules from the larger, which yet is absolutely necessary for the Continuance of Health and Life. On the contrary, *too easy*² a Divisibility of the constituent Particles in the Humours may be equally prejudicial, as the
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Humours will not be capable of maintaining Health and Life with Constancy, or in an equal Tenor.

¹ Too great a Cohesion in the Parts of the Humours, will hinder the Formation of them into smaller Parts necessary to Life and Nutrition.

² *Lewenboeck* has opened the Way for us to understand these Disorders, by his Enquiries into the Nature of the Blood. Having pricked his Finger with a Needle, and applied a small capillary glass Tube to the Wound, the Blood, by that means, ascended into the Tube, and he was capable of examining the same with his Microscope. He thus found that the Blood contained various Globules, some red, others yellow, and others perfectly pellucid; which last appeared, as it were, like a Shadow, and composed the pellucid Lymph. Each red Globule dissolved itself into six smaller yellow ones, of which it was composed; and, again, a yellow Globule dissolved itself into six pellucid ones, the smallest Order of which may perhaps be an Hundred distant from the first, that is, before they compose the Fluid which we call the Spirits of the Nerves. Thus, then, from the last Order but one of these Globules are generated the ultimate, which fill the Nerves; and this penultimate Order may perhaps be derived from the first or largest Order, namely, the red Globules by successive Gradations, in the Space perhaps of about twenty Days. If now these smaller Globules cohere together too strongly, so that they cannot be easily divided into lesser ones, a Disease ensues; more especially if they are likewise rough, or unequal surfaced, as well as too cohesive. Such Depravations of the Globules are observed in inflammatory Diseases, where the red Globules will not divide
into

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into yellow ones; whence only the first Order of Vessels continue to be filled, while the rest are exhausted; whence Weakness and Lowness of Spirits. But when the larger Globules too easily dissolve into smaller ones, then also the Body is weakened, since the Heart and larger Vessels are then too much exhausted; and the smaller Vessels and Cells being filled, a Dropsy follows.

§. 730. These morbid Affections of the Humours are certainly of the greatest Importance in Physic; and a right Understanding of them will lay the best Foundation of a Pathology, or Knowledge of Diseases; yet are they hardly to be discovered but by an accurate Observation of their Effects, which they manifest in the Body of the Patient: And from hence we may be likewise best supplied with a Knowledge of the particular morbid *Temperature* or *Constitution* of the Humours in different People.

Two Men, who have no Difference in their Bodies demonstrable by Anatomists, and who live in the same Manner upon the same Aliments; do, nevertheless, generate Humours differing from each other: For the same Food shall in one be converted into good Chyle, while the other shall be disordered from the same Aliment. This Difference seems to arise from there being a kind of natural Proportion betwixt the Humours themselves, and betwixt the Humours and solid Parts or Vessels, a Proportion betwixt the Blood and the sanguiferous Vessels, betwixt the sanguiferous, serous, and lymphatic Vessels, &c. if there is no other Change made in the Body in Proportion betwixt the Vessels
of

of the first Order and those of the second, from thence alone may arise a Difference in the Humour prepared by those Vessels. Hence it is impossible to give any general Rules for the Practice of Physic. For instance: I have had, at least, a Thousand Patients under my Care, to whom I have prescribed the *Syrupus Rosarum Pallidarum*, and have found it an innocent and friendly Purge in all; and yet, in the very next Patient, the same Syrup may perhaps purge so violently, as to excite Convulsions. There are Thousands of People who make Apples a Part of their Food; and yet are there some who faint away even at the Smell of Apples, and are almost extinguished with an incredible Anxiety: There are others, again, affected in the same Manner only from the Smell of Cheese. But these are Affections resulting from Causes too subtle to be known, being discoverable only by their Effects, and seem to depend upon that unknown Proportion which obtains betwixt some Humours and others, betwixt the Humours and the Vessels, and betwixt the Vessels of one Order and another.

§. 731. But if we consider the whole Mass of Humours together, we shall find their Disorders to consist principally either in too great *Fluidity*¹, too much Tenacity, too violent *Motion*², or too much Rest of them in the Vessels; or, lastly, some Disorder compounded of those before enumerated in them, §. 717, to 731.

¹ This will consist, 1. in the diminished Bulk of the alimentary Particles of the Fluids; 2. in the Diminution of their Cohesion; 3. from both these Causes

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Causes conjunctly. The contrary Causes will produce too great Tenacity.

² Motion changes the Humours and the Vessels, and likewise the Diameters of all the Pores or Mouths of the Vessels, which are enlarged in the same Proportion with the distending Powers, either by increasing the Velocity or the Quantity of the Fluids.

§. 732. But there are also considerable Disorders proceeding barely from a morbid Error of Place in the Humours, in themselves healthy; and of this Disorder there are two Classes: 1. When the Diameter of a Vessel is too much enlarged, so as to admit the grosser Humours into the *smaller* ¹ Canals, which by Degrees converge, or become narrower. 2. When the Humours are extravasated from any ruptured Vessel, and collected in *Spaces* ² formed by Distension betwixt the solid Parts of the Body. To these Heads belong *Inflammation* ³, a true *Aneurism* ⁴, a *Varix* ⁵, *Bruise* ⁶, *spurious* ⁷ Aneurism, an *Ecchymosis* ⁸ from an *Error of Place* ⁹ with respect to the Blood. To which add an *Oedema* ¹⁰, *Pustules* ¹¹, Dropsy of the *cellular Membrane* ¹², in the Head, *Thorax* ¹³, *Abdomen* ¹⁴, Uterus, Ovaria, Testicles, Scrotum, Peritonæum, and throughout the whole *Habit* ¹⁵ of Body from the Lymph offending, as the Blood before. Lastly, an *Emphysema* ¹⁶ or windy Tumor may proceed from the Air passing instead of the Lymph into the same Spaces. But the common Seat of all these Disorders is in the cel

lular Membrane, very easily distensible, and capable of Laceration.

¹ The most fatal Diseases may arise merely from a Transfusion of the most healthy Humours into the most sound, but improper Vessels ; which may happen, 1. when the Mouths of the lateral Vessels are distended by the Force of the Liquor acting upon the Sides of the larger Canal, so as to change the Mouths of the Vessels which are intermediate betwixt the largest and the smallest ; for this cannot happen without a Transfusion of the Humours into improper Places. The Aorta contains all the Orders of the decreasing or thinner Humours ; but then from the Aorta are derived laterally as many decreasing Vessels as there are Series of Globules in the Blood which the Aorta conveys : Hence every Series of Globules have their particular Diamèter. The first is that of the red Globules, which ought to be contained in the Heart, Aorta, and its sanguiferous Branches ; as also in the Vèna Cava and its sanguiferous Branches ; and this compleats the Circulation of the red Blood : But in the Sides of the least sanguiferous Vessels are the Orifices of the serous or second Order of Vessels, which refuse the red Globules, but admit all the other Humours in the Mass of Blood ; but now the Mouths of this second Order of Vessels, namely, the serous, being too much dilated, in that Case they will admit the red Globules which circulate in the first Order of Vessels ; from whence, in this Case, they will escape into the second Order of Vessels, which ought to have admitted only the serous and lesser Series of Globules. But the red Globules, thus admitted into the serous converging Vessels, will not be able to pass through them, but will stick fast in the narrower Part of the Vessel,

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fel, so as to cause Obstruction, Inflammation, and their Consequences. This is a Doctrine unknown to the Generality of Physicians, who, for the most Part, imagine there can be no other Cause of an Apoplexy, but that of an Extravasation of the Blood from a Rupture of the Vessels in the Ventricles of the Brain. It is true, that this is often the Cause of an Apoplexy, which yet may arise only from an increased Motion of the Blood, by which its red Particles are too forcibly drove into the small Arteries of the Pia Mater; whence the smaller pellucid Arteries in the cortical Substance of the Brain are so far dilated as to give Entrance to the red Blood, which producing a general Obstruction, may be the efficient Cause of an Apoplexy. But I may still venture to say farther, that there is no one Disease described by Physicians, but what may be produced barely from an Error of Place in the Humours with respect to the Vessels.

² Namely, in the cellular Membrane, which involves every Vessel and solid Part of the Body, so as to separate them from each other.

³ Namely, an Inflammation belonging to the first Class.

⁴ A true Aneurism is the Dilatation of an Artery, by which it loses its conical Figure, and forms a kind of Sacculus, within which the Blood moving more slowly, will thicken and fill the Sacculus by Degrees, not with a fluid Blood, but with a Substance like a Polypus.

⁵ A Varix is a true Aneurism, only seated in a Vein, and takes Place chiefly where the Valves are fixed; in which Place the Coats of the Veins being dilated, form the Tumor which we call a Varix.

⁶ By a Bruise we here understand not only a Contusion, but a livid or black Spot in a soft Part,

even from other Causes. When any Part of the Body is violently sucked, or freed from the Pressure of the external Air, that Part swells; and the Experiment may be carried so far, that at last the Blood will rush forth from the broken Vessels of the Skin. When a Cupping-glass is fixed to a Part, the Pressure of the Atmosphere is then taken off there, while it continues to act upon the other Parts of the Body; and therefore the Vessels being dilated in the Part not pressed by the Atmosphere, will suffer the red Blood to pass into the pellucid or serous Vessels, so as to cause a visible red or livid Spot. Or if a Bruise happens in any Part of the Skin, the larger Arteries which receive the Blow are so pressed, that they urge the red Blood into the smaller serous Arteries arising from them; so that if the Blood is not immediately repelled back again while it continues in a fluid State, it causes a livid or black Spot. The Causes of these Spots may be therefore twofold; 1. a Relaxation of the Vessels, while the *Vis à tergo* remains the same; or, 2. from a too sudden increased Pressure behind, without a Relaxation of the Vessels. Hitherto belongs that purple Colour, which sometimes suddenly overspreads the whole Body after Convulsions, together with the livid Circle which appears about the Mouth, or under the Eyes, in an Epilepsy; or lastly, a livid or black Colour diffused throughout the whole Skin, which the common People usually ascribe to an evil Spirit. The Cause of these Appearances is from a too great Rigidity of the Muscles, which exclude the Blood when convulsed, and oblige it to escape into the cellular Membrane, which never affords any great Resistance; so that from thence a Person may be suddenly deformed in the Colour of his Skin like an *Aethiopian*.

⁷ A spurious Aneurism is when a large Quantity of Blood is extravasated into the cellular Membrane from a ruptured Artery.

⁸ An Ecchymosis is a spurious Aneurism or Extravasation, not only of the Blood, but likewise of any other Humour besides.

⁹ *Helmont* justly calls this Disease an erring Lymph; the Serum erring causes yellow Tumors, Lymph causes pellucid Tumors, and Blood red Tumors. Man has therefore all Diseases (*in potentia*) in his own Body. Some Letters were given to a Man to be carried to the Boat or Pacquet for *Utrecht*; but when he came, the Boat had left the Shore, and therefore he ran after it as fast as he could, overtaking it at the Town of *Leytendorp*, and after delivering his Letters he returned Home; but being corpulent, and not used to running, brought with him a Peripneumony with various Spots throughout his Skin. Hereupon *Drelincourt*, who respected this Man, was called; but to no Purpose were his Endeavours, for the Man perished even before the third Day, with as much Precipitation as those afflicted with the Plague. Here was manifestly a fatal Inflammation brought on, by the Blood passing into the ferous Vessels, and the Serum into the lymphatic Vessels, &c.

¹⁰ An Oedema is a soft, cold, and pale Tumor, retaining the Print of the Finger when pressed. The Cause of this Disorder is an Extravasation of the aqueous Parts of the Blood from the sanguiferous Vessels into the cellular Membrane; and therefore the Tumor subsides again when the Humour is returned by the Veins. But there is another Species of Oedema, when the lymphatic Vessels are only preternaturally distended: But this does not so often happen as the former. There is still another Kind of this Disorder, termed *Oedema*

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Calidum or *Pblegmonodes*, when the lateral lymphatic Vessels, or those of the third Order, admit the Serum of the Blood, which properly belongs to the second; for naturally the Blood is only found in the first Order of Vessels, and the Serum in the second: But when the yellow Serum has entered into Arteries of the third Order, destined to receive the aqueous Lymph, from the Distension of the Vessels arises an inflammatory Tumor, with Heat from the Force of the Heart urging against the Obstructions.

¹¹ Pustules are Inflammations in the Extremities of the Vessels, where they terminate in *Cryptæ* or Cells, in which a thick wax-like Matter is collected, and incapable of being discharged. There are various Kinds of this Disorder denominated from the Consistence of the Matter, either an *Atheroma*, *Steatoma*, or *Meliceris*. In the first, the Matter of the Tumor is like Paste; in the second, like Fat or Suet; and in the third, like Honey or Wax: For these Disorders ought to be referred to Pustules; since, in the Beginning, they are no more than Pustules or small Pimples, which by Degrees enlarge to a considerable Bulk.

¹² Hence the Dropfy *Anasarca*, which, as the Word denotes, is an Effusion of Lymph or Water round the fleshy Parts in the cellular Membrane, which we know involves every Muscle and Tendon; but in the Muscles themselves this watery Lymph seldom stagnates: But, properly speaking, the Dropfy *Anasarca* is when the Body of the Patient appears, in a Manner, to be buried in the cellular Membrane, which accompanies the common Integuments distended with Water; but if the Water should be extravasated more deeply within the Parts, the Dropfy may be then more properly termed *Hypofarca*.

¹³ It is a common Thing in an Asthma to find, upon opening the Body of the deceased, that the Pericardium, and one or both of the Cavities of the Thorax, or all three, are filled with Water.

¹⁴ These Dropsies of the Abdomen are not all of one Kind. When the Abdomen is distended with Water, it is termed Ascites; but Tympanites, when from an elastic Matter, affording a hollow Sound. If the Dropsy is of the second Kind, or from contained Water, it is then contained either in the Duplicature of the Peritonæum, or in certain Hydatides, or in the Ovarium; or lastly, in the Cavity of the Uterus itself: For when the Os Uteri is contracted, a Cavity is formed within the Uterus, resembling, as it were, a second Venter. But you will perhaps object, Why does not this Water flow out from the Uterus? To which I answer, That the Reason hereof is not known, though the Truth of its not flowing out is certain. A surprising Instance of this Disorder is given us by *Drelincourt*, who being called to a Woman, who desired him to give her a Medicine for the Dropsy, he supposing her to be with Child, put her off, and would not give her any strong Purge: But when he was called again to the same Patient fourteen Months after, and found still the same Tumor of the Abdomen, he tried all Means without Success, repenting that he had neglected the first Hint; but after the Decease of the Patient, upon opening the Abdomen, he found the Uterus distended and filled with Water. Partial Dropsies of this Kind arise in the Ovaria of Women, and about the Testicles and in the Scrotum of Men.

¹⁵ As soon as ever the Blood becomes too much attenuated, or broke in the Texture of its Globules, it ceases to be confined in the Arteries. The

Cause of Death in tabid Patients, though commonly unknown, is from hence : The Lungs are corrupted or destroyed ; nor does the Blood acquire its necessary Compactness or Density, which ought to be derived from that Viscus ; but it continues thin and watery, so as to be incapable of Confinement within the sanguiferous Vessels, but it escapes into the lateral serous Vessels. But all the Vessels still in a great measure continue their Force of Contraction, while in the cellular Membrane there is little or no Resistance ; and therefore by the remaining *Vis Vitæ*, the poor watery Blood will be impelled into the Cells, where it will stagnate without corrupting. Thus the Fœtus will continue without putrefying for many Years in the Womb of its Mother, provided it has no Communication with the external Air ; but stagnating Humours which are viscid, and little or nothing saline, will be still more remote from Putrefaction.

¹⁶ Emphysemata, Inflations, or flatulent Tumors, which have sometimes such an extraordinary Appearance, that they are commonly supposed to arise from some supernatural Cause. The Ancients tell us of a Serpent Physer, which if it bites a Person, according to *Nicander*, occasions a Tumor of the whole Panniculus Adiposus, which becomes turgid with Flatus without increasing in Weight ; whence it is manifest, that the Tumor must arise, not from extravasated Humours or Water, but from an elastic Matter like Air. Such Tumors I have seen arise even from slight Causes. I saw the Arm of a strong Man which was wounded, and had been dressed by a Surgeon with a large Emplaster, applied so to the Wound, that a Quantity of Air was intercepted under the Skin ; so that this expansive and elastic Matter dilating itself into a larger Space, in-

sinuated

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insinuated itself into the unresisting Cells of the Panniculus Adiposus. But this cellular Membrane is continued throughout the whole Body; and therefore the Air received into it may wander through every Part of the Body, so as to occasion even a wonderful Tumor in the Scrotum itself. This Disorder is still more evident in Wounds of the Thorax, in which the Air penetrating that Cavity, and being confined by the Dressings, expands and insinuates itself into the cellular Membrane; so that in the Space of twenty-four Hours it spreads and inflates the whole Body of the Patient, even to the Hands and Feet. I saw a Child, who by a Fall down Stairs received a Wound, and by the Application of a Plaster, the cellular Membrane of the Face was so much distended, that the next Day one could not so much as discern his Eyes. These emphysematous or flatulent Tumors happen most frequently in those Parts of the Body, in which there is the least Fat, and where the Panniculus Adiposus is the most lax; as in the Scrotum, Forehead, Labia Pudendi in Women, &c. where the cellular Membrane being neither distended with Fat nor compressed by adjacent Muscles, is lax, and affords little or no Resistance.

§. 733. But these extravasated Humours stagnating, *putresc*¹ by Heat and Rest, and thus become purulent, ichorous, corroding, or *acrid*², so as to dissolve the tender solid Fibres; from whence follow Sinuses, Fistulæ, *Ulcers*³, *Gangrenes*⁴, *Mortifications*⁵, Cancers, and the like.

¹ But this Putrefaction is not introduced all at once, but by Degrees. In an acute Fever there is

a Putrefaction always in some Degree, introduced the sooner as the Fever is more violent, the Patient of a more strong Habit, and the Season of the Year warmer; but the contrary Circumstances hinder Putrefaction.

² Their Acrimony proceeds from a Corruption and Evolution of their Salts. The Ancients tell us, that the Humours in ulcerated Parts degenerate either into thick Matter, or into a more thin Ichor or Sanies, in which the Matter is so thin as not to cohere, but resembles the Washings of Flesh; or lastly, that they degenerate into a virulent, foetid, and caustic Liquor, like that discharged from a Cancer, or from the most malignant venereal Ulcers.

³ Abscesses and Ulcers are seated no-where but in the cellular Membrane; nor do they ever destroy the true Substance of a Muscle or Tendon, although they consume the cellular Membrane interposed betwixt the Muscles and their Fibres: Yet may the Acrimony of the Matter dissolve the Fibres. But this cellular Membrane is found throughout the whole Body, and is alone suppurated without the Skin and Muscles; this Membrane is indeed thus destroyed, but the Skin, nevertheless, remains entire and flaccid over the Source of the Matter.

⁴ A Gangrene takes Place in any soft Part, in which the Course of the Blood is obstructed in coming to the Part by the Arteries, or in returning back from it by the Veins.

⁵ A Sphacelus or Mortification is a Gangrene in a greater Degree; namely, seated in some large Part, and extended even to the Bones.

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§. 734. But these Classes (§. 699, to 734.) are the primary and principal Differences of Diseases, derived from their own Nature, and which are, for the most Part, so fruitful in producing other Diseases, that they may, on that Account, be deservedly reckoned among the *Causes of Diseases* ¹.

¹ Thus only from an Error of Place in the Blood by its escaping into smaller Vessels, may arise in the Head a Phrenzy, in the Nose a Running and Sneezing, in the Fauces a Quinsy, in the Parts about the Ribs a Pleurisy, in the Diaphragm a Paraphrenitis, and so in the Mesentery, Limbs, and other Parts; whence the Athritis, Rheumatism, and the endless Tribe of inflammatory Disorders.

§. 735. But it is become customary by Tradition among Physicians, to distinguish Diseases by certain external Accidents or Circumstances, which are common to a great Number of very different Disorders; which Distinctions have indeed their Uses in Physic, though they are often over-multiplied and subdivided with too great *Subtlety* ¹; and therefore omitting the rest, the principal of them follow.

¹ *Sennertus* and *Argenterius* proposed to us 300 Divisions or Classes of Diseases; but, as Lord *Bacon* well observes, they are like Cobwebs, finely spun, and without Use. But those Distinctions which are taken from the Causes and Effects of the Diseases themselves, ought not to be reckoned useless.

§. 736. 1. With respect to the Cause, a Disease is either *idiopathic*¹, *sympathic*², *protopathic*, *deuteropathic*, *hereditary*³, *connate*⁴ from the Birth, or *acquired*⁵.

2. With respect to the Subject, Diseases are distinguished according to the *Age*⁶, into those of *Children*⁷, *young People*⁸, *adult*⁹ or grown People, and *old Folks*¹⁰; and from the Difference of Sex, arise Diseases peculiar to Men, Women, *Virgins*¹¹, *Gestation*¹², *Lying-in*, *Suckling*¹³, &c. with such as are universal and common to all, or peculiar to only some of these.

3. With respect to the Time of Diseases, they are distinguished into *most acute*¹⁴, which terminate in four Days; *peracute*¹⁵, which end in seven Days; *acute*¹⁶, within twenty Days; all the rest being esteemed chronical, and of a long Duration: And each of these are again distinguished into vernal, *autumnal*¹⁷, *continual*¹⁸, *remitting*¹⁹, and *intermitting*²⁰.

4. With respect to the Effects of Diseases, they are termed *salutary*²¹, *benign*²², *malignant*²³, *curable*²⁴, *incurable*²⁵, mortal, *contagious*²⁶, &c.

5. But more especially with regard to the Stage or Progress of each Disorder, it is said to be either in its Invasion or *Beginning*²⁷, *Advance* or *Increase*²⁸, *Height* or *State*²⁹, *Declension*³⁰ or Decrease, and *Termination* or *End*³¹.

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¹ An idiopathic or original Disease, is one whose efficient Cause lies in the Part itself, where the Disease is seated; as when Blood is extravasated into the Ventricles of the Brain. And this is sometimes distinguished by the Name of a protopathic or local Disease. Thus a Pleurisy is a Disease so called from its Seat in the Pleura, which denominates it protopathic; and if the Inflammation arose first in the Pleura, the Disorder may be termed idiopathic or original.

² Sympathic Disorders are those which arise by Consent of one Part with another, made for the most Part by means of the Nerves, by which one Part being disordered, another will be so likewise. Such Disorders are likewise termed deuteropathic or symptomatic, as being themselves a Symptom or Consequence of another Disorder: As for Example, a Peripneumony arising from a Pleurisy, is a symptomatic Disorder.

³ Hereditary and connatural Disorders are different from each other. By the first, we understand some Imperfection in the first Rudiments of the Fœtus, in the Semen of the Male and Female. Every male Fœtus receives a Faculty in the Body of the Mother, by which the Beard will inevitably make its Appearance about the fourteenth Year of Age, at which Time in Females the Menstrues will likewise appear. This is termed an hereditary Disposition; but we likewise find such Dispositions to Diseases in People of the same Family, by which they are subjected, for Example, to the Epilepsy or the Gout, at a certain Age or a certain Season of the Year. But you can with no more Ease extirpate this hereditary Disposition to Disease, than you can hinder the Beard of a young Man from growing. Thus there are Cancers, gouty and calculous Disorders with pulmonary Con-

Consumptions, which attack all the Members of a Family at a certain Age ; but weakening or growing stronger in the Offspring according to particular Circumstances, till, in some measure, they spread through the whole Nation ; but if the Offspring or Children escape beyond a certain Number of Years, they are usually free.

⁴ Connate Disorders are often falsely termed hereditary, since they do not proceed from any seminal Imperfection, but from the Imagination of the Mother, or other Accidents while the Fœtus is confined in Utero. Thus when a Woman with Child happens to see an epileptic Person, and is afterwards delivered of a Child subject to epileptic Fits, this is not an hereditary Disease, and is therefore not an incurable Disease. Such an Accident happened to a Woman of Distinction in this City of *Leyden*.

⁵ Acquired Diseases are those introduced in the Body after the Birth by various Causes. I saw an epileptic Girl who contracted that Disease by looking earnestly upon a Beggar in these Fits ; and indeed all People, of very weak or moveable Intellects and Nerves, ought to be cautious to avoid such Spectacles. It was a Custom with the *Greeks* and *Romans*, to dissolve their Assemblies immediately, when an epileptic Person made one of the Multitude.

⁶ It is much to be lamented, that Physicians have not exhausted the Consideration of Diseases with respect to different Ages, nor accurately determined what Diseases are peculiar to each Age. *Hippocrates* has indeed enumerated some, and omitted other Diseases, to which People are subject at particular Ages ; and there are indeed great Vacancies in this Part of Physic, not yet filled up by

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by Observation, though extremely necessary towards the Treatment and Cure of Diseases.

⁷ Infants are subject to various Diseases from their feeding upon Milk, with which only they are or ought to be nourished until the cutting of their Teeth : In Infants, also, the Head and nervous System are much larger, in Proportion to the rest of the Body, than in Adults : For in a new-born Infant, weighing twelve Pounds, the Head weighs three Pounds ; but from thence the Head is less in Proportion to the Body, as the Child grows up. There are therefore Diseases of the convulsive Kind peculiar to Infants, merely from this greater Proportion of the Head and nervous System, which must be therefore, consequently, more liable to Irritation from the same Causes. Among a Thousand female Infants that perish, there is hardly one expires without being first convulsed ; and in these a slight Fever, cutting of the Teeth, Gripes, Strangury, &c. excite Convulsions, when they have very little Effect upon a Person of thirty Years old. There is again another Class of Diseases belonging to Infants from the curdling and turning sour of the Milk.

⁸ In young People the Vessels are extendible, and apt to yield, whence they become liable to a Plethora and acute Diseases.

⁹ But in Adults the Solids and Fluids are nearly equal in Proportion ; and therefore in these the most fatal Disorders usually follow from a small Excess, either in the distending or repelling Powers.

¹⁰ Old People are liable to Disorders from the too great Proportion and Strength of their Solids, and from a Deficiency of the Emunctories and smaller Vessels, which in old People are generally closed up, whence the offending Humours which
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ought to be discharged, are retained and produce Diseases.

¹¹ By the Disorders of Virgins we understand those which result from the Excess or Obstruction of the menstrual Discharge, to which Virgins are liable at the Age of Puberty, when they are capable of Child-bearing, and where they make more Blood than can be consumed by the Body, which must be therefore evacuated by the menstrual Discharge, or consumed by the Fœtus.

¹² The Disorders of Women with Child proceed from the Alterations made in the Circulation of the Blood.

¹³ That is in Women who make Milk of their own Chyle, and give it to the Infant; and therefore to this Head belong the Disorders incident to Chylification and Nutrition.

¹⁴ The most acute Diseases are those which make their Progress with the greatest Danger and in the shortest Time; as for Example, those which finish all the Stages in the Space of four Days, or in a shorter Time, perhaps in a Day, a single Hour, or even a Moment of Time; such is the pestilential Contagion which first invades People in the Plague, and kills them suddenly, as it were, by suppressing the Power of the Heart.

¹⁵ Peracute Diseases are those which terminate within seven Days, and do not extend to the eighth.

¹⁶ Acute Diseases are those which terminate within twenty Days, and which often end within fourteen Days. Nor ought it to be here objected, that *Hippocrates* has protracted some acute Diseases to the seventieth Day, and that *Sydenham* has extended the Small-Pox beyond the twentieth Day: For in these Cases the Patient does not die of the original Disease, but of other symptomatic or consequent

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sequent Diseases which result from the first. Thus an Empyema is not termed an acute Disease, tho' it is often the Consequence of a very acute Disease, namely, a Pleurisy.

¹⁷ It is certainly a very useful Distinction of Diseases into Vernal and Autumnal, the former of which begin in *February*, and terminate in *August*; but the autumnal Diseases enter immediately after, and continue to the Month of *March*.

¹⁸ The continual are such as keep up to an equal Height or Degree of Violence without any remarkable Risings or Fallings from the Beginning to the End.

¹⁹ The remitting are those Disorders subject to Paroxysms or Fits of Increase and Remission, without ever leaving the Body entirely free.

²⁰ The intermitting are such Disorders as return at certain or uncertain Periods or Intervals of Time, betwixt which the Patient is free from the Disease. When the Intervals are equal, the Disorder is periodical.

²¹ A salutary Disease is one that leaves the Body in a healthier Condition than it found it.

²² Benign Diseases are those which do not offer any great Injury to the Functions of the Body.

²³ Malignant Diseases are those which suddenly extinguish the animal and vital Powers.

²⁴ Curable Diseases are those which may be removed either by the (*Vis Vitæ*) Strength of Nature, by the Assistance of Art, or by both together.

²⁵ Incurable Diseases, on the contrary, are those insuperable both to Nature and Art: But the Number of both these Classes has not been accurately determined by many Physicians. Some Diseases incurable to the Ancients are not so to us. When a Limb is cut quite off by one Blow with a Scy-

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miter, the Patient will not be lost, provided a skilful Surgeon is at Hand to suppress the Hæmorrhage by compressing the Artery, or by applying the Tourniquet. The venereal Disease was incurable before the Time of *Jacobus Carpenfis*, and destroyed all those who were invaded by it: but that Person discovering the Efficacy of Mercury, began to apply it to this otherwise incurable Distemper; and by Experiments made at the Expence of the Lives of others, he learnt to prescribe Bounds to the raging Evil. After all our Lucubrations, I know not any one who has been able to cure an ulcerated Cancer. *Helmont* indeed tells us of a Man who knew how to destroy a Cancer by the sprinkling on of a Powder; and if such a Powder should be discovered, it would remove a Cancer out of the Class of incurable Diseases. *Cardan* writes, that he knew a Man, who by a certain Drink could dissolve a Stone in the Bladder. And there is Reason to hope, that as Art becomes daily more perfect, the Number of incurable Diseases will be perpetually lessening.

²⁶ A contagious Disease is when a healthy Person, by receiving a certain Matter from a diseased Body, falls into a like Disease. But it does not follow from this Definition, that the Disease must spread among many People; for in this Respect a Disease may be endemical, or peculiar to a certain People; and epidemical, or invading many People at the same Time, and yet not be contagious. But the Plague, Small-Pox, and Measles, are truly contagious Diseases; as also are Catarrhs or Defluxions to the Breast: Since we learn by Experience in Horses, that when one which has been disordered with a Peripneumony is put into the Stable among other Horses, his Companions will have the same Disorder.

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²⁷ The Invasion or Beginning of a Disorder is attended nearly with a healthy State, from whence it deviates by Degrees.

²⁸ The Increase of a Disorder follows its Invasion, and consists in a gradual Augmentation of the Disease.

²⁹ The Height of the Disease is when it no longer increases.

³⁰ The Declension of a Disease is a gradual Diminution of it from the Height.

³¹ The Termination of a Disease is when it ends either in Health, some other Disease, or in Death. All these Particulars ought to be well regarded, since the same Disease requires a different Treatment according to its several Stages.



Of the Causes of DISEASES.

§. 737. **T**HE Cause ¹ of a Disease is that which makes its present Existence; and is almost constantly some *real* ² or physical Thing, corporally present, or at least it is sufficient to produce a new State or Condition of the Solids and Fluids, which in a Manner is the Distemper itself; or else it removes or destroys something necessary to the Exercise of the Functions.

¹ A Disease is a physical Entity, and therefore all the Axioms which agree to a physical Cause, are applicable to a Disease; but we are said to know a physical Cause when we are certainly con-

vinced of some Entities, which cannot be conceived without likewise producing the Effect of which they are said to be the Cause. Nor do we possess the same Knowledge of Causes with the Creator; but by Experience we learn, that one Thing exists, and that if the Existence of another Thing is conceived to follow of Necessity from the former, then the first is termed the Cause, and the latter the Effect. A Phrenzy is a physical Entity, the Existence of which causes a Madness and Injury of the Brain, with an ardent Fever; now the Cause of a Phrenzy will be understood, if I am already acquainted with the Nature of Inflammation in the sanguiferous and serous Vessels, the Fabric of the Cortex of the Brain, and the Laws of our Intellects, agreeable to which, every physical Condition of the Brain raises particular Kinds of Thoughts in the Mind; for then I shall know that a Phrenzy is a continual acute Fever with an Inflammation of the Brain, disturbing its Actions and Ideas. But you will perhaps ask which of these is the Cause of the Phrenzy? I answer more briefly, the Inflammation of the Brain. But you will reply, that thus the Disease is the Cause of itself. Namely, an Inflammation cannot happen in the Cortex of the Brain, with a Force urging the Blood forward behind the Obstructions, without disturbing that Organ, nor can the Brain be disturbed, without the Presence of such a Cause; and therefore the whole Effect is perfectly the same with the whole Cause. For instance again, a Pleurisy is an Inflammation in the intercostal Arteries, accompanied with a continual Fever. One who considers the State of these Vessels as inflamed, will have a full Idea of the Pleurisy, and one who thinks of a Pleurisy, will necessarily think of this inflammatory State of the intercostal Vessels; and

the same is also true with respect to other Diseases. If we could understand the Nature of Things, like the Creator himself, whose Existence is much more certain than that of our imperfect Entities, according to the Demonstrations of *Socrates* and *Plato*, we should not then use the Name of Cause and Effect, but we should see every Thing as existing together: But as we can think only in a Succession, and conceive but a few Things successively together, from thence it follows, that the Thing conceived one Moment, will be less understood the next; and for this Reason therefore we call the Thing first conceived, the Cause, and that which comes next, the Effect; not because there is any real Difference betwixt the Cause and the Effect, since the Cause is inseparable from the Effect, and the Effect from the Cause, and differ only with respect to Duration in ourselves.

² An Entity is said to be real, when it truly exists; but Disease is truly a physical Entity, and the Cause of the Disease is the same Thing with the Disease itself, therefore the Cause of a Disease is a real Entity: Nor is the Cause of a Disease less real, though it be the Removal of something necessary to Health. For a Person to continue living, it is necessary for the Blood to continue in Motion, the Absence of which is a mortal Disease, yet not a mere Privation, but such a Collapsion of the Heart and Contraction of the Arteries, that the Blood no longer continues to flow in a Stream to the Brain, whence follows a Syncope or Death; and therefore a Disease, by Privation, is equally a physical Ens with a Disease which opposes as an Impediment any Function. Barely from this true Signification of the Term Cause, may be reconciled the Discords of Philosophers raised only from a Prejudice, by which they think the Cause

of a Disease to be something different from the Disease itself, though it is manifestly one and the same. Let the Globe A be suspended by a Thread, and another Globe B suspended in the same Manner, and let B strike in a direct Line against A; in that Case, according to the Laws of Motion, both the Balls will stop in the Contact, or rest at the Point of Contact for a short Time, during which, those two Globes will be, as it were, one Body, the Surface of each being flattened in their Points of Contact, by a receding of the small Particles of each Globe towards the Center. But soon after the two Balls restore their Parts to the same Arch in which they lay before, and from which they were flattened, whereupon the Ball A will repel the Ball B, and on the other Hand, B will repel A. But what is the Cause of their receding thus from each other? Certainly the Contact of one with the other, followed with a Restitution of the Parts of each, after being displaced and at rest. Unite all these Particulars together, and you will have an Idea of Resilition, of which these may be termed the Cause. An Apoplexy is a sudden Destruction of all the animal Actions, the vital Actions still remaining, or being rather increased: Here therefore the Source or Spring of the animal Actions is injured, that is to say, the Medulla of the Brain; and therefore any Cause depriving the common Sensory of the Faculty of exercising the animal Functions, constitutes an Apoplexy. Thus if the Head of a healthy Person be struck with a Hammer, so as to extravasate two Ounces of Blood within the Cranium, which Blood compresses the Brain, this causes an Apoplexy; for the Compressure of the Brain hinders its Medulla from the Performance of the animal Actions: If you remove these two Ounces of Blood, you
remove

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remove the Apoplexy; and therefore a Compression of the Brain is the proximate Cause of this Disease. Again, if a Nerve be so wounded that Part of it remains entire, it occasions a most severe Pain, the proximate Cause of which is such a Distraction of the Nerve as renders it near upon breaking: Remove this Distraction, either by dividing the Nerve quite in two, or by making its Parts approach towards each other, and the Pain itself is removed; therefore the proximate Cause, namely, the Distraction and the Pain, are the same Thing, and constitute the Disease.

§. 738. If the Cause pre-exists in the Body itself before it produces the Effect, it is said to be *internal*¹; but if the Cause exists without the Body, and occasions the Disease by being applied from without to the Body, it is then said to be external.

¹ When there is no Alteration made in a healthy Body, it continues well; but when it receives some Change from an external Cause without the Body, then the Disease produced is said to arise from an external Cause. But when any Change happens in a healthy Body, though from Health itself, which is itself a Series of Changes, from whence Disease may arise; in that Case the Disease is said to proceed from an internal Cause. And although there be a Cause existing in the Body, which is not of itself sufficient to produce the Disease without the Assistance of external Causes, from whence it may in Time excite Disease; even that Disease is also referred to those which arise from internal Causes.

§. 739. Internal Causes for the most Part injure first the *Humours*¹, and then the *solid Parts*²; but external Causes generally affect the Solids first and then the Humours, if we except perhaps a few Diseases arising from Contagion or *venomous*³ Causes.

¹ When a healthy Person begins to be afflicted with Diseases, from those Causes which are seated in the Body itself, the Disorder must necessarily arise in the Fluids, first altered, and then in the solid Parts.

² For before these external Causes can produce a Disease in the Humours, it is usual for them first to alter the Solids. Thus in a Wound or Contusion, the solid Vessels are first altered, as these Diseases are external. But a Pleurisy being an internal Disease, does not arise without an inflammatory State of the Blood; and from such a Disposition of the Blood only, the arterial System may be so affected as to cause a Pleurisy.

³ *Hippocrates* admits it as a Thing demonstrated, that the whole Body is perspirable from without inward, and from within outward. If now any Matter enters through the bibulous Veins in the human Body, so as to mix with and alter the Humours without meddling with the Solids, from thence arises a new Class of Diseases, in which the external Causes change the Fluids before the Solids; and hitherto belong the Classes of poisonous and contagious Diseases. When a Person has been blowed upon by the warm South Wind, and afterwards is exposed to a sudden North Wind, such a Person may be troubled with a Cough and a Catarrh, barely from the Change of the Wind, which was first warm and moist from the South, and then sud-

suddenly cold and dry from the North. But in this Case the Catarrh does not follow before the Vessels are contracted; and therefore the Air acts first upon the solid Parts, and then changes the obstructed or stagnating Fluids.

§. 740. The proximate or most *immediate* Cause of a Disease, is all that which occasions the whole present Indisposition which it constitutes; and it is therefore always the entire, efficient, and present Cause, of the whole Disease, whether it be simple or compound. The Presence of this Cause makes and continues the Disease, and the Absence of it removes the Disease; whence it is almost the same Thing with the entire Disease itself, and is therefore highly necessary, and extremely useful to be known or discovered.

¹ We are commonly taught, that a remote Cause is one which supposes an intermediate Cause, from which last the Disorder immediately follows. But there is no such Cause as this in Nature; for the Cause A which produced the Cause B is the same with B itself (§. 737.), from which it differs only by Succession in our Thoughts. If again the Cause B produces the Effect C, even thus B will be the same with C; and therefore A, B, and C, are one and the same Entity. There are not therefore properly any more remote Causes of Diseases. But with respect to the Effect to be produced, a Cause may be termed remote, when it produces an Effect which is not yet the Disease, but by the Accession of another Cause joined with this Effect, the Disease is produced from them conjunctly. In this Case the former imperfect Cause

is said to be remote, and the other perfect Cause the proximate; both which make the efficient and immediate Cause of the Disease. A Pleurisy is defined to be an Imperviousness of the Humours, rendered too thick to be propelled by the *Vis Vitæ* increased through the intercostal Arteries; but the remote Cause of this Pleurisy is said to be an inflammatory Spissitude of the Blood, but the proximate Cause is the acute Fever. In this Instance the remote Cause could not alone produce the Pleurisy, since there may be a Lentor in the Blood without that Disorder; nor yet is the Fever alone the Cause of the Pleurisy, since we have often Fevers without any Pleurisy; which is therefore occasioned both by the Lentor of the Blood and Fever conjunctly. Therefore from the Concurrence of remote Causes arises the proximate Cause of the Disease or Pleurisy; and therefore the remote Cause is but Half the Cause. Remove but the Viscidity or Thickness of the Humours, and the Pleurisy will no longer subsist; or if you remove the Obstructions in the Vessels, then likewise there will be no Pleurisy. These Conditions separately are termed the Causes, but conjunctly the Disease. When there is a Weight of 200 Pounds to be raised by two Men by their conjunct Forces, and the Strength of each of those two Men is estimated at the Force of a Hundred, in that Case one of these Men who assists the other, cannot raise the Weight alone, and is therefore the Cause only of raising Half the Weight; for if the Weight to be raised be divided into two equal Parts, he will then be able to raise the one Part of himself; or if the other Man comes to his Assistance, the whole Weight will be raised. To apply this Example, the first Man represents that which is by the Physicians commonly called the remote Cause, and

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the other the proximate, but not in a just Sense, since both Causes are equally near to the Effect, only they are distinct. The same is also true with respect to the Causes of Diseases, which conjunctly produce the Disease, which they are unable to do asunder. It is unjust, in such a Case, to call one Cause remote and the other proximate, and to ascribe the Effect only to the last. There is, for instance, a Steelyard, to which is applied a Hundred Pounds Weight on one Side, and Ninety-nine Pounds on the other, by which it continues in æquilibrium without Motion; but if to the latter is added One Pound, the former will ascend. But this single Pound is not to be esteemed the only Cause of raising the other Weight, but it is the Cause together with the other Ninety-nine Pounds conjunctly. Thus you may perceive the Difference betwixt remote and proximate Causes; whence it appeared to *Sydenham*, that the Consideration of remote Causes was very improperly rejected, as it was equally necessary to remove the remote Causes together with the proximate, and have them both in View. In a Word, the remote Causes conjoined are the proximate Cause; but if you know the proximate Cause, you know all that is necessary to be removed in order to a Cure.

§. 74I. The remote Cause of a Disease is said to be that which so changes the Body, that it becomes disposed or inclined to receive the Disorder, if another accessory Cause shall be added. It is not therefore the entire Cause alone, nor ever of itself sufficient to produce the Disease. Nor is it the other accessory Cause alone that produces the Disease, but both

both of them are equally concerned together, and therefore the Physician is directed to remove them both together. These two Causes conjunctly make the proximate Cause of the Disease.

§. 742. The remote Cause residing in the Body, is termed the proegumenal or *pre-disposing* ¹ Cause; and such, for Example, is the Temperature or *Constitution* ², a *Plethora* ³ or *Cacochymia* ⁴.

¹ The pre-disposing Cause is that Part of the Disease which existed before the Accession of the other Cause; but does not itself produce the Disease of which it is said to be the pre-disposing Cause, having but Half a Share in producing the Disease. For Example: There is a Disposition in a Person towards a Pleurisy, namely, his Body is hot, full of Blood, thirsty, heavy, inclined to Sleep, and under a spontaneous Lassitude; the Body now begins to be disordered, but is not yet pleuritic; for here the remote Cause of a Pleurisy acts, but is not of itself sufficient to produce a Pleurisy, which requires the Accession of another Cause. This pre-disposing Cause is always within the Body, and is so called from its being a Forerunner or Preparer of the Way to a Disease. If now to the preceding Disposition be added another Cause, capable of rendering the intercostal Arteries narrower, the thick Blood will there stagnate, be accumulated, and produce great Uneasiness in the Side, with a Fever, Shivering, and at length a Pleurisy.

² The Temperament or peculiar Inclination of each Person to or against certain Diseases; for in no Person living are the Humours the same as in another.

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³ A Plethora is such a Redundancy of good Humours, as does not of itself injure Health without some small Addition or Rarefaction, whence Disease must necessarily follow. We suppose the Humours to be healthy in this Case, otherwise it would be a Cacochymia rather than a Plethora; in which last the Humours abound to such a Degree, that they are near upon degenerating into Disease.

⁴ A Cacochymia is a Degeneration or Corruption of the Humours, before healthy, which constantly and necessarily is the Cause of Disease; but not of that Disease of which it is said to be the pre-disposing Cause, so long as it continues alone, but of other and different Diseases. But when external Causes excite the latent Cause, so as to generate a new Disease, then those external Causes are termed remote or procatactic.

§. 743. The Cause which is accessory to the remote Cause, and excites the same to Action, so that both together may produce the Disease, is termed the procatactic or occasional Cause. This puts the *pre-disposing Causes* ¹ in Action, so as to produce the particular Disease. It is sometimes internal, and sometimes external.

¹ Suppose among three People, one is of an atrabiliary Temperature, another is extremely plethoric, and the third is troubled with an ill State of the Juices. Cause these three People to run beyond their Strength, and from the increased Motion the atrabiliary Person will fall into surprising Disorders; the plethoric Person will have Inflammations in one Part or another, or perhaps a Fever and sudden Death; and the third Person will be subject to various other Diseases from the acrimonious

monious Matter forced into the minute Vessels. The first of the Causes here of these Diseases, is the Pre-disposition in the Patient's Habit, and the secondary Cause is the excessive Motion; but neither of these alone would produce the Disease which they occasion together conjunctly. Suppose again of two People, the one is plethoric, and the other dropical; if both are exposed to a cold Air, the former will be invaded with a Pleurisy, while the latter receives no Injury; therefore the same procatactic Causes produce different Effects, according to the various Dispositions of different People.

§. 744. These last or accessory Causes may most conveniently, and with great Help to the Memory, be reduced to *four Classes*¹, which will be very useful Heads under which to digest and find them; as,

1. The *Ingesta*, or Things taken into the Body, whether Air, Food, Drink, Medicine, or Poison, which may enter either through the Pores of the Skin, by the Nostrils, Mouth, Lungs, Oesophagus, Stomach, Intestines, or Pudenda, in a Form either visible or invisible, by Vapour, Draught, Morsel, Clyster, or Infusion.

2. The *Gesta*, or Things done by or in the *Body*², Motion or Exercise of the whole Body, or any Part, the several Passions of the *Mind*³, with the Rest of both; and hence Sleep and Vigilance are to be referred to this Head.

3. The State of the *Retenta*⁴ and Excreta Things to be retained in, or discharged from,
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the Body, whether they be healthy, excrementitious, or morbid.

4. Things *applied*⁵ externally to the Body, as *Air*⁶, Vapours, Fomentation, Bath, *Cloaths*⁷, Liniment, Ointment, *Emplaster*⁸, or any wounding, contusing, or eroding Body.

¹ These which are usually called the Nonnaturals, are Things in themselves indifferent, and which being applied to a healthy Body under proper Circumstances and Regulations, support and form Part of the Body; but by an ill Application of them, they occasion Disease. By our Aliments we are preserved in the same healthy State, whereas without them Health would soon degenerate into Disease. But if to a sick Patient Aliments are plentifully supplied, they greatly increase the Disorder. They are termed Nonnaturals, because they have not yet become Part of ourselves, nor assumed our own Nature, as they may by good Use. It is certainly not without Reason, that they have been thus denominated by the Ancients; but *Johnston*, whom I chuse to follow, with more Propriety distinguishes the procatarctic Causes into four Classes.

² The several Actions of the Body, both natural, vital, and animal, the Consideration of which are of the greatest Use in Medicine. For Example: I am a Physician called to a Patient, and as yet know nothing of his Disease; in order to which I must necessarily learn its proximate Cause, which is the Disease itself, composed of the predisposing and accessory Cause. I therefore call over these, and enquire first, whether the Disorder is to be found in the Temperature of the Patient; and if so, I remark it as found; otherwise

I pass on to the Plethora, and observe whether that has any Share in the Disease: As if a Patient tells me he was well three Days before, but then began to perceive a Lassitude and spontaneous Heaviness of the Body. But besides these Causes, there must be some external accessory Cause; and therefore I ask the Patient what he has eat or drank, what Medicines he has taken, or whether he has received any Infection from People afflicted with contagious Diseases, or by any other Accident; whether he has eaten any bad Shell-fish, or Sallad upon which Toads have spit or spued their Froth, &c. If there appears no Defect in that Class, Enquiry must be next made, whether there is any Thing amiss in the Excreta or Retenta; and in this Manner are all the four Classes of the accessory Causes to be run over, till the true Cause is found. There was an Infant, who had a Fever without any manifest Cause; it cried much, and was convulsed, for which I could find no Cause by all my Enquiries, till at length I ordered the Body of the Infant to be undressed or stripped naked, by which means we found a Needle thrust through the Cloaths into the Flesh; by removing which, and applying a Formentation, the whole Disease was removed. If I had not thus learnt the Cause of the Disorder, no bleeding or other Medicine would have recovered the Child to its Health. I have seen People who have persuaded themselves for certain, that they have been troubled with the Stone in the Kidney, because they made bloody Urine, which became afterwards purulent, and was discharged with great Pain: But upon strict Enquiry it appeared, that Cantharides had been externally applied to their Body. By attending to all these Particulars, you will in Time become a Physician; but without this Consideration you will wander altogether in the Dark.

³ There is a Book extant, concerning the Method of preventing Infection in acute Diseases by spitting. It is a very ancient Custom amongst the People of *Asia* to spit when they see any Thing disagreeable, from which we abstain, because spitting among us is reckoned indecent; but in reality the ancient Custom is founded upon Nature. In the Small-Pox, Men are generally invaded first in the Stomach by swallowing their Saliva, together with which the volatile Venom which flies in the Air passes into the Stomach; and from hence the first Symptoms of Infection shew themselves in the upper Orifice of the Stomach. It has been demonstrated an Hundred Times in the Plague, that none are infected but those who swallow their Saliva and the Air; from whence follows an Anthrax in the Stomach, the most fatal of Diseases: For the Air with all the contagious Particles in it, are immediately applied on all Sides to the whole Mouth; nor can we swallow a Spoonful of Water, or a Mouthful of Food, but what is mixed together with the Air which we breathe.

⁴ The Generality of Motions in the human Body depend upon the common Sensory, which is subject to great Changes, which we call the Passions of the Mind; and therefore it is no Wonder, that the Motions of the Body should be disturbed or changed by the Passions of the Mind.

⁵ If such Things are retained, as ought to be expelled from the Body, or if such Humours are expelled as ought to be retained, it may be the Cause of Diseases. Even the most healthy Blood may offend by being retained when it ought to be discharged. The most healthy Bile retained, may cause Diseases for want of being discharged.

⁶ The human Body has three Surfaces, the first of which is the common Skin and Cuticle. 2. The

second is the Surface of the Mouth, Fauces, Wind-pipe, Bronchia, and Vesicles of the Lungs, which come into Contact with the Air in Respiration; 3. and lastly, the Surface of the alimentary Tube, the Mouth, Fauces, Oesophagus, Stomach, and Intestines, both large and small.

⁷ From the Cloaths frequently arise wonderful Disorders. I knew a Person subject to a spitting of Blood, who never put on a tight Garment, but he had a Fit of that Disorder; and I remember another Person who made bloody Urine from the same Cause. Girls are usually laced very tight, and therefore in such as are phthifical, the Blood is thus pressed into the Parts least resisting, from whence Diseases are brought upon themselves. From hence appears the Necessity of enquiring into these Particulars by the Physician.

⁸ Who would believe, if they had not experienced, that a mercurial Plaster applied to the Soles of the Feet, could, by raising a Salivation, cure an Itch or Leprosy of the whole Body? But there are a Thousand Cases of the like Nature which may happen various Ways; and therefore it is necessary for the Physician to give due Attention to all these Particulars.

§. 745. The preceding Causes are by others divided into six Classes, under the Title of Nonnaturals, and are reckoned up in the following Order; 1. Air; 2. Aliments, or Food and Drink; 3. Motion or Rest of the Body; 4. Passions of the Mind; 5. Things retained or discharged; 6. Sleep and Vigilance. They are thus denominated, because by Use or Abuse, they may either assist and support, or destroy Nature; and to these Heads may be also reduced

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duced the Causes before enumerated; but I think the former Division is much more commodious and ready to be consulted than this last.

§. 746. The Air, when too hot, dries up the Moisture of the *Eyes*¹, *Nose*², Mouth, and *Wind-pipe*³, heats the Blood too much in the Lungs, dries up its small Vessels, and renders its Blood thicker, and by both these means hinders the free Action of the Lungs from whence may arise many Diseases: Such a too hot Air always *dissipates*⁴ the thinner external Humours, and renders the internal more thick and acrimonious, consumes the most moveable Part, and *compacts*⁵ together the more viscid, and at length dries them up; such an Air therefore diminishes the watery, spirituous, volatile, and saline Particles of the Humours; and on the contrary, the saline, fixed, gross, oily, and tenacious Parts, together with the earthy and acrimonious Particles involved in the former, are at the same Time increased, accumulated, and united together into *irresolvable*⁶ Masses; from hence then follows an Imperviousness of the Humours, together with an Elongation and *Weakness*⁷ of the Solids, with their respective Consequences, Obstruction, Induration, Inflammation, a depraved Concoction of the alimentary Juices, a Putrefaction of the Humours, Costiveness, Thirst, the Strangury, red or high coloured Urine, Yellowness of the Sweat or other Humours,

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with

with acute, hot, and dry Diseases, which are more especially the Consequences of an Air thus too much increased in Heat, and which yet offers greater Injury to the *nervous*^s and lymphatic System, with their respective Functions.

¹ From this Cause it is, that the *Ægyptians* have their Teeth so extremely firm or sound, as we find them in complete Sets after so many Ages have passed in their Mummies; but the same People, by the thirtieth Year of their Age, are almost deprived of their Sight, the Cause of which is from the scorching Rays of the Sun reflected to the Eye.

² They who have been a whole Day walking through the scorching Sands, will in the Evening be without the Sense of Smelling, from the drying up of the Schneiderian Membrane.

³ When we exercise the Body much in a hot Air, the Lungs do not long retain their Lubricity; for according to *Ruyfch*, there is a Humour ex-hales into the Vesicles of the Lungs, from a Suppression or drying up of which, arise fatal Diseases.

⁴ So long as we are in Health, we are always surrounded, to a certain Distance from our Bodies, with an Atmosphere of moist Vapours: For if in the midst of a hot Summer, a Piece of Ice is taken out from the Cellar, and held at some Distance from the Hand, you will see a thick Vapour like Smoke exhale from the Hand, not because the Vapour at that Instant only exhaled from the Skin, but because being perpetually exhaled and condensed by a cold Body, it then becomes visible, though it was not before to be seen, in the same
Manner

Manner as our Breath becomes visible in the Winter, and escapes the Sight in Summer. Hence it is evident, that the whole Body is retained, as it were, in a kind of vaporous Bath; but when a warm Air blows upon us, it carries off this Atmosphere, which is succeeded by another, till at length the Moisture of the whole Body is exhausted. How great a Force the Air has in this respect, may appear from the vast Exhalations of Water from Plants in a few Hours Time, as Dr. *Hales* demonstrates by Experiments in his *Vegetable Staticks*.

⁵ From hence it is that in *Asia*, a Camp of Soldiers can hardly remove three Miles, but the People are exhausted and perish; for in this Country the Air is hot to seventy and eighty Degrees of *Farenheit's* Thermometer; and here if Water be drank, it sweats out from the Body as through a Sponge, as *Bernier* writes in his Epistles from *Indostan*; in which he complains, that he was wasting through his Skin by profuse Sweats; and that the Ink dried up so fast, that he could scarcely write: Nor can the drinking of Water in this Case qualify the Blood, which when thick and tenacious like Pitch, refuses to mix with Water.

⁶ Hence atrabiliary Diseases are more frequent in hot Countries, and in *Greece* they are very frequent, according to the Descriptions of *Hippocrates*; which still hold true with respect to our Inhabitants of the hot Countries; whereas we ourselves in the colder Climates are neither subject to generate the Atrabilis, nor to put it into Motion to produce the like Disorders.

⁹ From hence it is apparent, why the Bodies of People inhabiting the northern Nations are always strong; and on the contrary, why they are softer and weaker towards the Equator: For the

Particles of Fire insinuate and remove the constituent Particles of Bodies from each other, they rarefy the Air, and expand Water into Vapours, and they expand Oil, Spirits, Wood, Metals, &c. in all their Parts, so as to make them acquire a greater Bulk. But the same Fire being applied to the Fibres of the human Body, will cause them to elongate and become weaker, for the Bulk of the Solids and Fluids will be increased, and consequently the Power of the former will be diminished; for the closer the elementary Particles are to each other, the more firm the Body, and the Reverse. Hence the Strength of People in hot Weather fails them; whereas in Winter, or in a cold Air, they are stronger.

⁸ A hot Air acts upon no Part of the Body more powerfully, than upon those tender Parts which we call the Nerves, whose Fluids being the most subtil of all others, are the soonest dissipated. From hence it appears, why People who have very weak and tender Nerves, are more especially subject to those Diseases which arise from a too hot Air.

§. 747. A very cold or *freezing* ¹ Air shortens the solid Fibres, and renders them more *dense* ² and strong, whence it increases their Action upon the Humours; but when the same Air *thaws* ³ or grows warm on a sudden, it dissolves or destroys the Fibres. The same very cold Air thickens and condenses the Humours, dries and *contracts* ⁴ the Lungs, and coagulates their Blood; whence Obstruction, Inflammation, Driness of the Membranes, short Breath, Cough, Defluxions or *Catarrhs* ⁵,
Mucus

Mucus or Phlegm, Matter, a Gangrene or *Sphacelus*⁶: But if under these Circumstances of a cold Air, the Body be violently *moved*⁷, then the Action of the Solids upon the Humours, and of the Humours upon the Solids, is so far increased, that they are highly attenuated, and too much increase the Perspiration, whence *Voracity*⁸, Weakness, Faintings, or sudden Death; but if, on the contrary, the Body is at Rest, the extreme cold Air then occasions a Dulness or *Numbness*⁹, a *Pain*¹⁰ in the Limbs, *Scurvy*¹¹, &c.

¹ Namely, so cold as to harden Water into Ice; though the Cold may be increased beyond that of Freezing half as many Degrees, as there are Degrees of Heat above the freezing Point in the hottest Summer: And I observed twenty-six Years ago (*Anno* 1709.), that the warm Water dispersed in the Air, was immediately froze into a kind of Hail before it fell to the Ground. But to determine the Degrees of Cold, we ought to discover its mean or middle Degree; nor is there any Thing more entertaining in Physics, than the Improvements made by the Moderns, by which they can determine the intermediate Degrees of Qualities. Betwixt the most intense Heat and extreme Cold, there is a certain intermediate Degree, which in some Places almost continually remains the same the Year round without Alteration; for in the very deep Cave of the Observatory at *Paris*, belonging to the Royal Academy, Water never freezes in the Winter, nor grows warm in the Summer, but the Air is of an equable Temperature; and by observing this Degree of Heat for

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many Years, the Members of that Academy have discovered the middle Degree betwixt Heat and Cold.

² The Body of a Person is contracted by Cold, and rendered less. The Cloaths which could be hardly put on the Body when heated in Summer, are found too large in Winter. Nature seems to have intended this with Design, that the internal Heat might be increased. The Venters, says *Hippocrates*, are warmer in Winter and Spring, because in those Seasons of the Year they possess more of their natural Strength; and therefore in these Seasons the Digestions are quicker, as he tells us; for these Actions result from the Force of the Vessels upon the Fluids, which is increased by the Cold, and must therefore hasten the Concoction or Assimilation of the crude Humours into animal Juices. *Helmont* therefore in this Place finds Fault with *Hippocrates* without Reason.

³ There is no Change throughout Nature more pernicious, either to animal, vegetable, or mineral Bodies, than that of suddenly freezing and thawing of them alternately and often. Even Metals themselves which are suddenly emerged in cold Water after they have been heated quite hot, become brittle as Glass. Flesh is preserved eatable for a long Time in a freezing Air; but so soon as it thaws, it dissolves into a soft flabby Mass. It is well observed, that Coughs are never more frequent than when there are sudden Alterations in the Air; when the Air becomes suddenly hot after being cold, and then again changes to cold, there is at no Time greater Danger of a pulmonary Tabes.

⁴ There are Instances of Men dying suddenly in extreme Cold, without any previous Symptoms of Disease, which is a Calamity frequently happening both to Men and Beasts in the most north-
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ern Countries; but the Cause of Death is from a sudden Constriction of the sanguiferous, and a Coagulation in the Lungs of the smaller Vessels, which are now exposed to the naked Contact of a most severe cold Air.

⁵ A cold Air produces Diseases of the Cuticle, of the *Schneiderian* Membrane, Lungs, Oesophagus, Stomach, and Intestines, so as hardly to leave any Remains of Health. Some have falsely imagined these Catarrhs to be a critical Secretion for cleansing the whole Body; but the most healthy People have never any of them had any such Catarrh during their whole Life, since it only happens when the *Schneiderian* Membrane, being first heated, is afterwards suddenly cooled; for then the Extremities of the Vessels are contracted, the Humours are inspissated, and then again of a sudden the Solids are relaxed, and the Humours attenuated. Hence *Hippocrates* justly recommends dry Fumes of Frankincense and Mastic to strengthen the relaxed *Schneiderian* Membrane. From hence also it is that People are continually blowing their Nose, so as to foul many Handkerchiefs in the Space of twenty-four Hours, when they would hardly foul one so much in a Month if they were in Health.

⁶ The most healthy People by extreme Cold lose the Extremities of their Lips, Nose, Fingers, and Toes, by a Sphacelus or Mortification. Hence the *Romans* have justly expressed the Force of Fire and Cold by the same Term. Thus *Virgil*:

———— *Penetrabile frigus adurit.*
Piercing Cold burns.

It causes a sudden Mortification, by contracting the solid Parts, and condensing the Fluids.

⁷ There

⁷ There is no Cause capable of destroying the human Body so soon, as when the severe external Cold is overcome by Heat generated by muscular Motion of the Body. As for Example: When Men are skating upon the Ice, more especially if at the same Time they move contrary to the Wind which then blows; for in this Case the Solids act violently upon the Humours, so as to generate Heat by Attrition, which overcomes the external Cold, whence the Blood becomes heated to a Degree more than usual; for the Winter's Cold, when Water begins to freeze, is the thirty-second Degree of the Thermometer, but the Heat of the human Blood is the ninety-second Degree; so that there are sixty Degrees of Heat thus generated by the Motion of our Solids and Fluids. Hence there is hardly any Remedy so potent against chronical Disorders, as that violent Exercise of skating upon the Ice. But the Effects of Cold are according to the Air which is applied; for it is a popular Error, that the Motion of a Fan or Bellows makes the Air colder; for the Wind which comes from a Pair of Bellows used for Metals, does not appear by the Thermometer to be in the least colder than the common Air. But the Cause of this apparent or seeming Cold is as follows: The Blood of a healthy Person is always many Degrees hotter than the Air in which we breathe, nor can the Air arrive to the same Degree of Heat with the Blood without destroying us. They who work in Foundries or Iron Works, and such as labour in the Stoves of the Sugar-Bakers, breathe a most hot Air, which after suffering a short Time, they are obliged to depart and rest themselves upon the Bed, returning again to their Work after they are recovered; and if they were not thus to depart at Times from their Work, they would faint
away,

away, or fall down like dead Bodies, and soon putrefy. Hence therefore the Atmosphere of perspirable Vapours with which our Skin is surrounded, always exceeds the Heat of the common Air; but this Atmosphere of Vapours is continually carried off by a Wind, which brings the colder ambient Air in its Place: And from hence it is that we perceive a greater Cold when the Wind blows, though the Air of the Wind is in itself no colder than the Air which is at rest.

⁸ The Humours being condensed, will be more violently rubbed against the more compacted and strong Vessels; but Heat generated by Attrition, is as the Density and Asperity of the contiguous Bodies; and therefore an increased Density of the Solids and Fluids is followed with an increased Heat and copious Perspiration. Hence continual and new Supplies of the Sweat and perspirable Matter are carried off by the Air, by which a very great Quantity of the Humours is destroyed, so as to exhaust the Vessels in a few Hours to such a Degree, as to interrupt the continued Pressure of the Blood to the Brain and Cerebellum; which being also at that Time too thick, does not supply the usual Influx of Spirits, &c. and therefore if you give a Man, who is thus violently exercising upon the Ice, thin liquid Nourishment, or spiritous Liquors, he will faint away; but if you give him hard brown Bread and Bacon, or other Flesh salted and dried in the Smoke, he will be very well supported by that solid Food; for the Viscera now acting more forcibly upon the solid compact Aliment, will continually add some new Chyle to the Blood. Hence in the Epistle of *Diocles to Antigonus* there is the old Aphorism, That more Food ought to be given as the Cold is greater, and the Drink less and stronger; but the more intense the
Heat,

Heat, the less ought to be the solid Food, and the more plentiful and dilute the Drink.

⁹ When a Person at Rest is oppressed with sudden Cold, there follows a disagreeable Sense; but if the same Cold be supported for a longer Time, such an agreeable Sleepiness follows, as inclines the Person to give way to it, even at the Expence of his Life: For if the Person suffers himself to be captivated thereby, the Brain, which now begins to rest in its Office, will wholly and ever rest, so as to bring on the most pleasing Death.

¹⁰ This appears from no History more evident than from the Journal of the *Dutch*, who spent the Winter at *Spitzberg*, in which there is a Description of their Sufferings; most of them being killed by the Severity of the Cold, their Limbs became stiff and extremely painful, till at length Death itself put a Period to their Sufferings. They built themselves a wooden Hut, in which they made a Fire; but when the Extremity of the Cold came on, they could neither keep themselves warm, nor move their Limbs, but lay helpless in their Beds, with their Limbs contracted and full of Pain from the Scurvy; in which Manner they died one after another, till at length the last who survived writes in the End of the Journal, “ All my Companions
“ have miserably perished, and myself who now
“ write expect my approaching Fate.” But the *Dutch* Ships, which came there the next Spring, found nothing but the dead Bodies of their Companions.

¹¹ The Scurvy is the most formidable Disease of the northern Countries.

§. 748. If the Air be too moist, it relaxes and weakens the Fibres, especially those of
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the Lungs, whose serous Moisture it also causes to be retained, increased, and accumulated, by suppressing the Perspiration in them; from whence follow *Coughs*¹, *Peripneumony*² or Inflammation of the Lungs, serous Defluxions and Diarrhæas of the like Kind, Torpidity or Aversion to Exercise, with Fevers, &c. but if intense Heat is joined to this great Moisture of the Air, it occasions sudden *Putrefaction*³ of the Solids and Fluids, and serous Defluxions when accompanied with intense Cold.

¹ The Air which enters the Lungs every Moment, is at first dry, but carries with it a great deal of Moisture, when it is expired; which Moisture is carried off also by the Atmosphere, with which the whole Surface of our Bodies is encompassed. If now the Air is too moist and cloudy, it ceases to take up the moist Vapours from the Lungs and from the Skin; whence the Lungs are overcharged with Moisture, and we are in a Manner almost as if plunged under Water, and a Cough arises, by which we endeavour to discharge the serous Humours from the Lungs. Hence we have Coughs and Diarrhæas from a southerly Wind; which agrees with the Observations of *Hippocrates* and *Malpighi*.

² When a moist Air is too long applied to the human Body, it causes a Relaxation and Flaccidity of all the Parts, and even Plants themselves perish sooner, as they are longer exposed to the Injuries of a too moist Air.

³ Nothing more powerfully destroys the Parts of Animals, than Moisture applied with Warmth, as is evident from the Dissolution of the most compact Hartshorn suspended in warm Vapours. If

Pork

Pork is hung up in a moist Air of 50 or 60 Degrees warm, you will in twenty-four Hours Time find it putrid; whereas in dry Air of the same Heat, it would keep three Times as long, though not without contracting a Rancidity. Hence *Hippocrates* derives epidemical Diseases, and even the Plague itself from a warm, cloudy, and moist Air; but if a moist Air is cold, it causes epidemical Catarrhs and Defluxions.

§. 749. An Air which is too dry, produces much the same Effects with that which is too hot; that is to say, it dries up and deprives the Body of its due Moisture.

§. 750. An Air too *heavy* ¹ compresses all the Vessels and Humours of the Body, more especially in the Lungs; whence the Resistance to the Heart is too much increased, the Circulation of the Humours is retarded or suppressed, and Death brought on.

¹ Such an Air applied to the external and internal Surface of the Body, renders it strong, and adds Firmness or Strength to all the Vessels. For Strength is that Force by which the Fibres resist Elongation, and this Elongation is hindered by the Air, by whose Pressure the Parts are now more violently retained together. Hence the same Air more violently compresses the Vessels as it is heavier, renders them narrower or smaller, and increases the Resistance of their Sides against the contained Fluids, and consequently increases their Attrition and Heat; hence therefore we are brisker and better in Health as the Air is heavier; and hence it is that Men who work in subterraneous
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Caverns easily grow hot, though the Air itself is cold. It is customary with the common People to denominate a cloudy, dull Air, heavy; but it is certain that a serene Air is the heaviest, especially when the Weather is set in to be fair for a considerable Time. When the Air is too heavy, it may at length suppress the Circulation of the Blood through the Lungs, by dilating them with a greater Force, and pressing them with a greater Weight against the Pleura, and filling a larger Capacity of them, leaves a less Space for receiving the Blood. But it is not often that these Inconveniences ensue from a too heavy Air, which is never so far increased naturally, as to occasion the Death of any Person; and in general, healthy People find themselves better as the Air is heavier: For the Air seldom ascends more than one 28th Part of its Weight, beyond its mean Gravity, which sustains 28 Inches of Mercury in the Barometer, equal to 340256 Feet of Air in Height; so that the Access above the mean Weight of the Air, being but one 28th Part, causing the Mercury to ascend an Inch higher, is a Difference very easily tolerable by People in Health. But asthmatic People are usually worse under a heavy Air; for so soon as the Wind turns to the North, the Mercury ascends in the Barometer, and such People are invaded with an asthmatic Fit.

§. 751. If the Air be too *light*¹, by its diminished Pressure it dilates the Vessels, and rarefies the Humours; whence a Tumor or Distension of the former, an Eruption of the Humours, or a forcing them into improper Vessels or Receptacles, whence the Disease (§. 732.) before mentioned: But at this Time the contractile Force

Force of the Vessels is also diminished, by which they ought to resist Dilatation, especially in the Vessels of the *Lungs*²; whereupon the Respiration is suppressed, the Blood is accumulated in them, and a sudden Peripneumony or Death ensues. From what has been said concerning a too heavy or light Air, may be also deduced the Effects of an Air either too *dense*³ or too rare.

¹ A too light Air is therefore much more pernicious. Animals can easily bear an Increase in the Weight of the Air, equal to three Inches of the Ascent of Mercury in the Barometer; as appears from the Experiments made by Mr. Boyle, in his Machine for condensing Air: But if you diminish the Weight of the Air so far, as to cause the Mercury to descend three or four Inches below its common Station in the Barometer, all Animals struggle for Life; and if you remove one sixth Part of the Weight of the Air, they expire. Hence it is manifest that an Increase of the Air's Weight seldom offends, but that a Diminution of its Weight is highly prejudicial; for in this Condition of the Air the Humours are less compressed, more rarefied, and the Vessels less expanded; for the Dilatation of the Vessels being resisted by the Weight of the incumbent Air, and that Weight being now diminished, it follows, that the Vessels will be more dilated. Thus the Arteries of the second Order may be so far dilated, as to admit the Humours of the first; that is to say, the red Blood may pass into the serous Vessels, as we observe in the Skin, when the Pressure of the Air has been removed from it either by sucking or cupping; from whence an Error of Place, with

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Inflammations, and their various Consequences. Thus an immense Tumor or Swelling, with the Appearance of a Bruise, is observed throughout the whole Body of an Animal, included in the *Boylean Vacuum*.

² The Lungs in a living Animal are larger than they would be if the atmospherical Air was admitted into the Cavity of the Thorax; for whenever this happens, then the Lungs collapse into a less Compass; and therefore the Musculi Meso-chondriaci of the Lungs are continually in a State of Distension or Violence, endeavouring to contract themselves, which Contraction is hindered by the Air expanding the Lungs internally; so that if you diminish the Weight or Pressure of the Air, you will increase the contractile Power of the Lungs. Hence it is, that when the Air is lighter than usual, it is not capable of expanding the Lungs to their proper Dimensions, because its Weight being diminished, the contracting Fibres of the Lungs continue their former Strength. From hence follows a Difficulty of breathing in a light Air, the Breath becoming short and quick, from the Difficulty of drawing the Air into the Lungs, which is an Asthma opposite to that mentioned before (§. 750.), which is increased by a moist Air. Hitherto may be referred those Appearances in Animals which die in the *Boylean Vacuum*; for they pant and expire with extreme Anguish.

³ For the Density of the Air is equal to its Weight, and therefore the Weight being increased, must increase the Density, and being diminished, will diminish its Density.

§. 752. The *Weather*¹, *Season*² of the Year, *Soil*³ or Country, the *Sea*⁴, *Mountains*⁵, *Lakes*⁶, Ponds, *Rivers*⁷, *Vapours*⁸, Exhalations and *Meteors*⁹, &c. produce such Alterations in the Air, as create various Diseases, not so much from the Nature, Qualities, or Properties, of the Air itself, as from the Nature and Action of the Substances *mixed*¹⁰ with it; and therefore these Effects of the Air ought to be sought after, and accounted for in those Causes.

¹ By the Weather we understand the Face of the Heavens, together with the Æther and Atmosphere of Air which encompasses a Country perpendicularly; and therefore hitherto belong the Degrees of Longitude and Latitude.

² Namely, the Accession and Recession of the Sun to and from us, by which it becomes twenty-two Degrees nearer to us, and again recedes as far from us, which makes the Difference between Summer and Winter.

³ By the Soil or Country, we understand a Part of the Surface of the Globe, which every one inhabits: This may be sandy, marshy, bituminous, or abounding with Mines, &c.

⁴ The Sea is that Collection of salt Water, in which all marine Bodies are contained, produced, and destroyed; but this Water is not altogether composed of the mere Element and Salt, but it likewise contains a bituminous and bitter Substance, intolerable to the Palate, and which cannot be taken from it by Distillation: For *Marfilius* has demonstrated by Experiment, that it ascends with a disagreeable fetid Smell in the Still. Add to
this,

this, that the Sea buries an infinite Number of Animals both great and small, which are more numerous here than upon the Earth, and some of these Fish, we know, are of a monstrous Size; and besides these, the vast Number of Men who have been devoured within the Space of six Thousand Years. Hence the Sea ascending to and falling from the Coast alternately, may render whole Countries unhealthy, because by the great Heights of the Sea, the Springs may be infected with a Saltiness left in the Earth, after the Recession of the Sea: And hence the *British* Forces have been used to denominate *Flanders* their Church-yard. Every Sea may be therefore suspected with regard to the Healthiness of a Country.

⁵ Mountains are the most eminent Parts of the Earth, in which the Air is the least foul with Exhalations. Hence *Helmont* explains the Words of David, *Who shall dwell in the Mountain of the Lord?* To signify who shall dwell in perfect Health.

⁶ Lakes are larger Collections of fresh Water stagnating, and Ponds are lesser Collections of stagnant Water.

⁷ Rivers are fresh running Waters, the Nature of which has been considered by Dr. *Halley*, who has computed the Quantity of fresh Water which may be evaporated in a given Time with a certain Degree of Heat, from the Surface either of salt or fresh Water; for less exhales in Proportion, as the Water is more impregnated with Salt. That Gentleman has demonstrated by Experiments, that the Water evaporated from the Sea, Lakes, Rivers, &c. is condensed by the nocturnal Cold over the Surface of the Earth, and collected together in Clouds about the Tops of the Mountains, where the Air is extremely cold, so as to condense the

Clouds, which from thence distil or run down by the Sides of the Mountains in Brooks or Springs, which meeting together, form the larger Rivers; for there are no Rivers arising up in a Country, unless there are some high Mountains at their Head; and therefore in the plain Country of *Holland*, we have no Brooks or Rivulets of this Kind. From the forementioned Experiments of Dr. *Halley*, one may explain the not yet well understood Saying of *Solomon*, namely, why all the Rivers run into the Sea without swelling or increasing it? Namely, because there is as much Water exhaled from the Sea in Vapours, as there is discharged into it by the Rivers; the Vapours being again condensed and scattered over the whole Face of the Earth in the Form of Rain, or else collected together by the Tops of the Mountains, and from thence distilling from running Brooks or Rivulets, which compose most clear Rivers of running Water descending from the Mountains. But this Exhalation in every Part of the Earth is various, according to the different Seasons of the Year, with which likewise the State of the Atmosphere itself must be changed.

⁸ By Vapours, we understand something moist or watery in the Air; but by Exhalations, we mean a dry Fume or Vapour, like what ascends from burning Sulphur, or from a putrefying Animal; and these are both of them various in every Country of the Earth.

⁹ By Meteors, we understand those Changes which appear in the sublunary Heavens, or within our own Atmosphere. Among the Meteors hitherto known, some are inflammable, as Lightning and Thunder, wandering Lights upon the Surface of the Earth, which frequently appear before the Plague, with Darts and Thunderbolts, if there
are

are any such Instruments of *Jove*. Lightning is, indeed, generated by Heat and Moisture together, and therefore we frequently observe it after very hot Weather. There are other Meteors again rather watery, as Dew, Hail, Rain, Snow, &c.

10 These Particulars have not hitherto been examined into as they ought. The Earth itself has a great Share in these Matters; for the nearer we approach to the Sun, the more intense is the Cold. In the highest Mountains of *Peru*, the Tops are found covered on all Sides with white Snow, never dissolving by the Influence of the Sun's scorching Rays; though, at the same Time, at the Bottoms of those Mountains, and in the Valleys, the Heats are almost intolerable; for the Heat of our Air is more owing to Reflexion, than to the Sun's Rays only. Indeed our Heat increases when the Sun's Rays are conveyed to us perpendicularly, and decreases when the same Rays fall upon us obliquely. But even in the same Climate, the Heat of the Air is not the same in every Part of the Country; for when there are high Mountains placed northerly, the Summer will be very hot; but if the Mountains lie southerly, the Air will be almost perpetually very cold. Hence we see the different Conditions of the Air, and its Action upon human Bodies, not following from its four Qualities, but resulting from the Particles of Bodies which float in it. I have demonstrated before in my Chemistry, that the Air is not only the elastic Body subjected to so many Experiments by Mr. Boyle, but that it is also a Chaos, or confused Mixture of the small Particles of all Bodies, which are raised by Fermentation, Putrefaction, or Fire, volatilizing the Parts of Bodies; and that it contains even Gold and Silver, as far as those Metals are capable of being rendered vo-

latile, or of being suspended in the Air, by increasing their Surface with respect to their solid Contents. Nor can any one determine the Effects of the Air, unless he is acquainted with the Nature of the predominating Effluvia suspended in it, according to the several Seasons of the Year in the same Country.

§. 753. But the Winds also act upon our Bodies, either by their *Motion*¹, or as they convey to us the Qualities of the Air before explained (§. 746, to 753.), whence it is impossible to say any Thing of them which shall agree to all Times and Countries; but a *chorographical*² Knowledge of the Place, the Soil of which has been surveyed on all Sides, compared together with the Seasons of the Year, will in some measure afford a true and useful Information. But the Winds likewise produce considerable Effects or Changes, often by following each other in a sudden and successive Order; though they act primarily by their Heat, Cold, Moisture, or Driness, which alter the Condition both of the Solids and Fluids in the animal Body.

¹ Wind is Air put in Motion. My Lord Bacon has very well considered the Winds, and Mariotte has improved upon him; but there is still something remains which has been understood by neither of them, and which neither results from the Heat, Weight, Cold, nor Exhalations, contained in it. But the Winds or Currents of Air, are of two Kinds, according as they are equable continuing in the same Course, or variable from

an infinite Number of Causes. Of the first Kind are those stated and periodical Winds observed betwixt the Tropics; for there the Sun arising in the Morning, drives forward the Air next before it, so that a Wind goes before the Sun; and on the other Hand, when the Sun sets in the Evening, a Wind returns contrary to the former, because the Air heated by the diurnal Rays of the Sun, occupies a greater Space; and therefore an easterly Wind blows every Morning, and a westerly Wind every Evening. But the other variable Winds may be altered by an infinite Number of Causes. Now these Winds act upon the human Body, either 1. by their Motion, by which they are applied to the Lungs with a greater Force; for a calm and stagnant Air acts upon the Lungs only by its Weight; but when the same Air is applied to the Lungs with a considerable Motion, the Lungs are thereby more pressed in Proportion to the Velocity of the Current, so that a Man who rides against the Wind, can hardly expire the Air, which he very easily admits by Inspiration. Moderate Winds are very salutary, as they produce the same Effects upon the Body, with an Increase of the Air's Weight; and hence Animals breathe more freely, and are better in Health, while the Air is agitated with a moderate Wind, but become short breathed and indisposed, so soon as the Air stagnates. 2. The Air in Motion removes from us our Atmosphere of warm Vapours, and places a colder Air in its Room; whence it is, that our Bodies are cooled by a Wind, which carries off our Atmosphere of Warmth. But a Wind increased to the greatest Degree of Violence, produces the same Disorders with an Air that is too heavy.

² Those Physicians entertain themselves with mere Fancies, who pretend to determine what shall

be the Effects of a northerly or easterly Wind, calling a north Wind dry, or a south Wind moist, &c. for a Person who would explain the Powers of Winds ought to remember, that the Winds bring to us those volatile Matters which abound in the Country from whence they blow. Thus if any one is desirous of being acquainted with the Power of the Winds at *Leyden*, he ought first to have an exact chorographical, or a large geographical Map of the Country, extended for many Leagues around, placing the City of *Leyden* in the Center; and then by the Compass to determine the Course of the Winds from all the adjacent Countries towards the City. If the Sea lies to the north of the City, the north Wind will then be of a very different Quality to what it would be, if a large Tract of Land lay to the North instead of the Sea. I have demonstrated in another Place, that the Winds are capable of carrying or conveying the Effluvia of Bodies which they pass over, to the Distance of above twenty Miles. An easterly Wind is healthy to the *Dutch*, but very unhealthy to the *English*. *Marriotte* has given us Tables, in which the Celerities of the Winds are calculated, together with the Spaces which the most violent Winds have been observed to pass over in a given Time; but *Kruquius*, a *Dutchman*, has more especially left us beautiful Observations upon the Winds, which would have been a very useful Work, if any one had continued the same; for he remarked the Manner and Time of the Air's travelling from one Place to another. If there were ten or a dozen Men in *Europe* like those two before mentioned, by remarking the Winds for the Space of eighteen or twenty Years, we should be furnished with a more certain Knowledge of their Nature. For this Purpose one ought to remark

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how long the Wind blows in any one Point, and with what Celerity, remarking whether the Wind comes over the Sea, Mountains, Marshes, &c. from whence one might gain a reasonable Knowledge of the Effects of the Wind. What *Hippocrates* of *Greece* has wrote concerning the Power of the east or westerly Wind, must be quite different with respect to the same Winds blowing over *Holland*. The north Wind indeed can never be like the west, the former being almost continually cold, and the latter warm and moist: But yet if the north Wind should in its Course pass over Marshes, Bogs, &c. it must be very different from the same Wind passing over a dry, champaign, or a hilly Country. An easterly Wind is, among us in *Holland*, very warm in the Summer-time; for all Winds which last a long Time, bring with them the Qualities of the Air peculiar to the Countries from whence the Winds blow. When the north Wind has continued blowing for two Months, all that Time the cold northerly Air is brought to us, whence follows a dry and cold Season; but the southerly Winds in Autumn bring moist Vapours, and cause the Season to be wet and rainy. Hence it is evident, that a Physician ought to be acquainted with the Chorography or Nature of the Country surrounding the City, which is the Seat of his Practice. When the People of *Illyria* begged the Advice of *Hippocrates* to guard them against the Plague, he gave them none, only advised the *Greeks* to correct the Winds blowing to their Country from *Illyria*; for the Plague, says he, lies behind those Mountains, which Mountains are divided from each other by these Plains or Ways, through which the north-easterly Winds are used to blow at this Season of the Year in the Dog-days, at which Time they bring the pestilential Air from
Illyria

Illyria to *Greece*; and therefore, says he, you must stop up those Passages betwixt the Hills. By this Advice he preserved the *Greeks* from a Plague, without any other Cause or Divination than by being acquainted with the Course of the Winds, which in *Greece* are usually more constant than in other Parts. If now the *Greeks* who consulted *Hippocrates*, had not believed that the North-easterly Winds were the Cause of the Pestilence, as they were induced to believe it by the Fame and Success of so great a Man, the whole Country might have been lost. But it is easy to understand, that one may prognosticate with more Certainty from Winds which return at stated Times or Seasons of the Year, than from those variable Winds which observe no stated Time. The *Etesiae* or North-easterly Winds were annual, and therefore *Hippocrates* could boldly pronounce that these pestilential Disorders would be mitigated at the Time when those Winds should blow, &c. Certain it is, that his Book concerning Water, Air, and Situation, abounds with accurate and faithful Observations, which make it deserve a Place in every Library.

§. 754. The Food and Drink may offend so as to produce Diseases, either by their Quantity or Qualities.

§. 755. In Quantity they may offend either by Excess or Defect.

§. 756. If they offend by *Excess* ¹ in Quantity, the Stomach is thereby too much distended; whence follows a *Constriction* ² of the two Mouths of the Stomach with a convulsive Mo-

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Motion, its Vessels are compressed, and at the same Time the Dilution, Digestion, Attrition, Division, and Expulsion, of its Contents, are *hindered*³; from thence follows a Difficulty of *breathing*⁴, a *depraved*⁵ Circulation of the *Humours*⁶, *Crudity*⁷ or Indigestion, flatulent Belchings, Sickness at Stomach, *Heart-burn*⁸, *Vomiting*⁹, a *Putrefaction*¹⁰, Vertigo, Confusion of the Senses, Cachexy, &c. all which Disorders being here once formed in the Stomach, are hardly to be corrected, when they have extended themselves with the Blood and Lymph, so as to deprave the other Functions.

¹ In this Case we suppose a Person to be perfectly in Health, and to use wholesome Food, and to offend only by eating too much.

² They who have filled their Stomach with too great a Quantity of Food, retain it there too long by rendering that Organ incapable of emptying itself; a Truth which was taught first by *Hippocrates*, and afterwards by *Helmont*, and which we are now assured of by Experiment. For in a very full Stomach the gastric Arteries are compressed by the Food, so that the Course of the Blood through them being stopped, occasions a Palsy of the Stomach. Even if one drinks suddenly too great a Quantity of cold Liquor, it will be retained more powerfully in the Stomach, as the Mouths of that Receptacle are more firmly closed by the greater Distension. Gluttons do not discharge the Wine by Urine, of which they drink immoderately and of a sudden, but they bring it up again by Vomit; or if they retain the same, they perish with an Apoplexy, as *Wepfer* has demonstrated by many
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Experiments and Observations ; for the Fibres distended, react and close the Stomach.

³ The Foods taken in too large a Quantity, are not properly digested and attenuated in the Stomach, suffering no more Division than if you endeavour to beat them into a farinaceous Paste in a Bladder which is filled quite full ; for in such a Bladder you will make very little Impression upon the Contents ; whereas if the Bladder was only half full, you might by the same Force easily attenuate and divide the contained Matter.

⁴ A Difficulty of breathing follows, because the Diaphragm is thrust upward by the distended Stomach, so as to diminish the Space of the Thorax required for the Dilatation of the Lungs.

⁵ The Aliments received into the Stomach over-filled, does by too long Retention in a warm Place, consequently, begin to ferment and expand, not from an Increase of its Substance, but from the Air which is extricated or generated from the Aliments, by which the Food being swelled, the Stomach will be more distended, so that one's Eyes appear turgid after Dinner ; and even in this Manner the Stomach of a Sow has been known to burst : For the voracious Animal suddenly filling herself too much after fasting, lay down upon the Ground, and expired soon after.

⁶ For thus the Aorta is compressed, so that the Blood cannot so easily descend ; and is therefore sent in a greater Quantity to the Brain, where by its Pressure, or by over-filling the Vessels, it occasions Sleepiness, a Vertigo, or even Apoplexy.

⁷ That is to say, the Aliments either retain their own Nature, or put on some other Quality, foreign to that of good Chyle.

⁸ Namely, a Pain in the upper Orifice of the Stomach, which is extremely nervous and sensible, so

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so as to afford that Pain which we call the Heart-burn, from a Distension or Acrimony of what is contained in the Stomach.

⁹ This Vomiting almost constantly follows when a Person is in Health; and Children hardly ever come from a Feast without vomiting, which follows as a necessary Consequence of their over-feeding, as they are generally used to a moderate and regular Diet at other Times.

¹⁰ A Putrefaction follows in the Food retained too long in the Stomach, so that it runs off in that putrid State by a Diarrhæa within twenty-four Hours after it was taken; but no Chyle is formed from thence, and the Stomach especially is more or less affected with a Palsy. For as by retaining the Urine too long, the Fibres and Nerves of the Bladder are violently compressed and strained beyond their Tone, so that the Urine can never be afterwards discharged but by a violent Contraction of the Diaphragm and abdominal Muscles; so the Stomach is liable to the like Disorder from a like distending Cause. For there are some People, who after the Crapula languish all the remaining Part of their Life, from the Action of the Stomach being destroyed, its muscular Fibres having lost their contractile Force by too great a Distension, whence a continual Lientery, in a greater or less Degree, has ensued. For when the Stomach has continued in a State of Distension for the Space of twenty-four Hours, all that Time the Veins receive little or no Blood from the Arteries, so that their Sides collapse and almost concrete together, where at the same Time the Nerves are almost destroyed by the Compressure. Hence it is that Abstinence proves so useful after Feasting, that by Rest the Fibres may recover their proper Tone.

§. 757. But if the Aliments are deficient by *Fasting* ¹ or Abstinence, as this is a mere Privation, it can do no Harm of itself; but then, in the mean Time, the Actions of Life continuing, wear away and destroy the solid Parts, *dissipate* ² the more subtil Humours, and inspissate the rest; so that the constant and repeated Attrition still remaining, the Parts are dissolved, their Oils and Salts are extricated, volatilized, and rendered acrimonious or caustic, so as to *corrode* ³ the smallest and most tender Vessels, putrefy the Humours, and render the Breath stinking. Hence the Spittle becomes saline, acrid, *bilious* ⁴, or putrid; and more especially in the Stomach and Intestines, occasions Belchings, Nausea, Faintings, voracious and insatiable *Appetite* ⁵, followed afterwards, with an *Aversion* ⁶ to Food, intense *Thirst* ⁷, Driness, Weakness, Gripes, a rumbling *Noise* ⁸ in the Bowels, an *Accumulation* ⁹ and *vomiting* ¹⁰ of Bile, Leanness or wasting of the Habit, *Over-watchfulness* ¹¹, *Epilepsies* ¹², Fevers with *Madness* ¹³, and *Death* ¹⁴ itself.

¹ Fasting being of itself a mere Privation, can be no Cause of Disease; but the vital Actions continuing in the mean Time, the Humours are, by the perpetual Motion, thence changed, and the Solids are wore away, the more subtil Humours are expressed and exhaled, and the Machine destroys itself. The following Disorders are therefore not owing to fasting, but to the Actions of Life; but fasting is of a worse Consequence when accompanied

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nied with violent Motion or Exercise of Body ; whereas those who sleep, or use no Exercise, can sustain fasting for a long Time.

² According to the Experiments of *Sanctorius*, Perspiration is greatest about eight Hours after the last Meal.

³ This is an important Observation of *Tschirnhause*, in his Book *De medicina mentis & corporis* ; namely, that fasting occasions a Putrefaction of the Humours throughout the whole Body : Hence the Urine, Sweat, and Breath, are fetid, and become intolerable even to those, to whom they were before inoffensive ; and the more fetid are they in Proportion as the Person has fasted longer.

⁴ The Bile and pancreatic Juice, after fasting, ascend into the Stomach, where they are mixed together ; whence it is that those who have fasted a long Time, are said by *Hippocrates* to be bilious, not that they generate a larger Quantity of Bile, but because it then ascends into the Stomach, and shews itself by Vomit.

⁵ All Bitters provoke the Appetite, and therefore the Bile contained in the Stomach will cause an Irritation like other Bitters ; as if the Stomach contained a strong Infusion of Wormwood and the lesser Centaury.

⁶ The Stomach being irritated a long Time by the acrimonious Bile, becomes at length insensible ; whence the Appetite ceases, and the Person has an Aversion to Food.

⁷ Thirst follows from a Dissipation of the most subtil Juices ; nor are there any Humours at Hand suitable to fill the Nerves.

⁸ The Bowels of a Person fasting make a murmuring Noise ; and the unlucky Servant of *Plautus* complains, that he had a Clock in his Belly, by which he was directed to the Time of the Day without

without the Help of a Sun-dial; and if any one denied it, they might be convinced by hearing.

⁹ When we are in Health a large Quantity of Bile is generated, as may appear if it were only from the Largeness of the Liver; but when this Humour descends into the Intestines, and is there retained without Food to obtund its saponaceous Force, it becomes more acrimonious and thin. Even when the same Humour has been absorbed by the mesenteric Vessels, it there becomes more acrid by Motion, and returns again, after Secretion, a second Time into the Intestines, where it is accumulated. But when a Person eats Bread or other Food, the Bile has something to obtund its Acrimony or saponaceous Force, by which both the Food and the Bile itself change each other. But when the Bile continues alone, it corrodes or vellicates the Stomach, and excites Vomiting: And I have myself experienced, that when I have been sometimes obliged by urgent Calls to neglect taking Food, I have from thence found myself in a very unusual Condition, sour Belchings, or a Bitterness, usually ascending into my Mouth at the same Time.

¹⁰ After long fasting, vomiting is easily excited from the slightest Cause. The Stomach being empty, is flaccid, and gives no Resistance, while the Intestines being irritated to Contraction, expel the Bile and pancreatic Juice into the lax and unresisting Stomach, which being thus irritated, excites a Vomiting.

¹¹ It is well known to every one who has fasted but a Day, that they cannot sleep at Night.

¹² People who have been subject to an Epilepsy, relapse again into that Disorder by fasting.

¹³ Animals which die with Hunger, are generally affected with Madness before Death.

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¹⁴ But Death follows even in a very little Time, when not only the Food, but also Drink or Water, are denied to the Animal. In Animals killed with Hunger, *Redi* found the Intestines quite pale, and extremely clean within-side; and therefore fasting may be sometimes serviceable to cleanse the Body, and especially if at the same Time Water be drank, the Viscera will be well cleansed; which Practice will conduce much to Longævity, according to the Observation of Lord *Bacon*, who remarks this to have been a Practice among the Inhabitants of the Desarts in *Asia*.

§. 758. From hence it appears, that Abstinence too long continued may create *worse* Disorders, than too great Fulness; and that it is much more difficult to cure Disorders arising from Inanition than from Repletion, agreeable to the Dictates of *Hippocrates*.

¹ Some Physicians, upon seeing Disorders arise from too great Repletion, think it adviseable to remove or cure them by Abstinence; but from the ill Success of this Practice they have been obliged to desist. There is no great Difficulty in emptying a Patient where there is too great a Fulness; for to this Purpose we may invoke to our Assistance the Lancet, Clysters, Purges, &c. but it is much more difficult to fill a tabid and extenuated Body with good Juices; and therefore *Hippocrates* justly concludes, that a too spare Diet may do more Damage than too great Repletion.

§. 759. But the Vices which consist in the Qualities of the Food or Drink may be more commodiously reduced to Acrimony, Viscidity, or Oiliness,

§. 760. The Acrimony predominating either in the Food or Drink is chiefly saline; but this saline Acrimony is either *muriatic* ¹ or acid, which last is either *simple* ² and natural, or the Result of Fermentation. The first Kind of Acrimony causes *Thirst* ³, Hoarseness, Roughness, Driness, and *Stiffness* ⁴ of the Solids, with Acrimony in the Humours, especially in the *serous* ⁵; a Dissolution of the Texture of those Humours, an Indisposition of the Lymph and Serum to *nourish* ⁶ the solid Parts, the most minute and tender of which are *dissolved* ⁷ by the Juices; whence gnawing Pains, and the *muriatic Scurvy* ⁸. The other Kind of Acrimony which is a simple and natural Acid, being most commonly accompanied with a *Roughness* ⁹, is also astringent, incrassates and *curdles* ¹⁰ the Humours, and creates in them an *acid* ¹¹ Acrimony; whence *shooting* ¹² Pains, the Heart-burn, *Paleness* ¹³, *Itch* ¹⁴, and other cutaneous Diseases; and this Kind of Acrimony is most predominant in Garden Fruits not perfectly ripe. The third or last Kind of Acrimony resulting from Fermentation, abounds mostly in acid Wines and *Vinegars* ¹⁵, and produces the same Effects with the former, only milder, though by a too plentiful Use of these the Serum and Lymph are infected with an acid Acrimony; whence the *Rheumatism* ¹⁶, Gout, and Disorders of the like Kind.

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¹ This operates (1.) from the Nature of Sea Salt; (2.) inasmuch as the Sea Salt is not pure, but in some measure corrupted by the animal Juices; for when Salt has been employed upon Meat, it loses its Saltiness or preserving Faculty, agreeable to the Observation of our Saviour. I am not ignorant, but that Sea Salt may be extracted from Urine after a long continued Putrefaction; yet it is in some measure changed, and does not possess all the Properties of Sea Salt.

² Such as resides in crude unripe Garden Fruits, or some Rye Bread, which has been retained three or four Hours in the Stomach. The other which is fermented as in Leaven, Wine, or any other fermented Liquor.

³ It excites Thirst not by Driness; for Sea Water drank is so far from abating the Thirst, that it rather increases it.

⁴ Of this we had an Instance in a Girl at *Leyden*, who being troubled with a vitiated Appetite, used to eat Salt by Handfuls, continually carrying it about in her Pocket, till at length all her Joints became stiff and insensible; so that she formed a living and breathing Statue. Thus salted Flesh becomes rigid, and so tough, that it can be hardly divided by the Teeth; and if it has been charged with too great a Quantity of Salt, it becomes quite an useless Mass: For the Salt and Flesh together form almost a stony Substance.

⁵ It more especially affects the Serum and other thin Juices; for Sea Salt more readily dissolves as the Liquor is more aqueous, but is very difficultly dissolved in Oil. But this Kind of Acrimony dissolves the Humours, and does not coagulate them; so that it renders the Blood more thin and dilute than it naturally ought to be.

⁶ The Blood of a healthy Person is so mild or sweet, that it excites no Pain after being dropped into the Eye; nor does it excite any Uneasiness in a Part so exquisitely sensible: But if the least Particle of Sea Salt be dropped into the Eye, it excites an intolerable Pain. Salt is therefore useless to our Bodies; unless they should be too weak, and liable to too great Exercise. But then the Salt adheres so firmly to our constituent elementary Parts, that it can hardly be washed out or discharged by any Means. Salt Bacon does not part with its muriatic Acrimony, though it be boiled for many Hours in Water.

⁷ The Humours being loaded with common Salt and propelled into the Vessels, abrade the Sides of these Vessels more than if they contained no Salt; and therefore those who live two or three Months upon salt Provisions, have their Gums inflamed; so that if they are but touched, they bleed profusely, and the whole Body is overspread with livid or blue Spots.

⁸ Our *Dutch* Sailors being much more saving than the *English*, feed only upon Barley and salted Fish, breathing at the same Time the Sea Air; but by this way of living, continued through long Voyages, they become immoveable in their Limbs, and are obliged to lie Day and Night in their Beds, without stirring, like dead Bodies, to avoid the most excruciating Pains; and their Gums at the same Time putrefy, and fall away from the Teeth. So soon as they reach Land, those of the Sailors which remain well, carry the others ashore, and supply them with acid Fruits, Sorrel, and other green Herbs, with which they make Broth, adding thereto some Lemon Juice, which they call *Puspas*; and by this Course of Diet only are they cured, and restored to their Strength in three or four Days Time.

⁹ When

⁹ When an Acid is joined to an earthy Substance, it renders the Parts of our Bodies stronger, as we experience even by chewing an unripe Quince; soon after which the Skin of the whole Mouth feels thick and hard, the Influx of Juices is suppressed, and they seem to be coagulated. Such is the Nature of austere and unripe Garden Fruits (especially Grapes), which are so hurtful that they even render Swine scrophulous, and subject to the Measles, when they are suffered to feed much upon those unripe Fruits.

¹⁰ For austere Substances being mixed with the Blood, Serum, or Lymph, curdle them.

¹¹ There is no Acid in a healthy Person, nor is there any Acrimony more repugnant to the Nature of our animal Humours.

¹² These Pains are like as if the Parts were wounded by a Lancet, whence the *French* call them cutting Pains.

¹³ Acids always induce a Paleness in the Body. If a Child has got a Habit of drinking Vinegar, not only the Face, but even the Lips, will look pale; and in general all People look pale, whose digestive Powers are so weak as not to overcome the ascescent Inclination of the Chyle.

¹⁴ Namely, that Kind of Itch which arises from a bad Diet; whence the grosser Particles arriving at the Skin, obstruct the Perspiration. Country Children, who devour Apples blown down by the Wind, are generally troubled with the Itch, or cutaneous Eruptions of the like Nature, about Autumn; and these Eruptions of the Skin are different from those which proceed from too great an Use of salt Provisions at Sea.

¹⁵ Vinegar indeed, moderately used, dilutes and thins the Blood.

¹⁶ Acids are not much less penetrating than Water; and therefore when they are taken in great Plenty, they overpower our digestive Faculties, and enter the Blood, retaining their own acid Nature; whence follows the Gout, and a Destruction of those small Vessels in which the acid Particles are stopped; of which we have an Example in People who drink Plenty of Rhenish Wine while new and full of Tartar, which at length overcomes the Force of Nature, and the Acid penetrates unaltered into the Articulations. I do not say that every Gout arises from hence, but that this is one of the principal Causes producing the Gout, which in this Case is more violent than that proceeding from the Use of Spirits.

§. 761. Another Kind of Acrimony is that of an aromatic or spicy Nature both in the Food and Drink, consisting for the most Part of *acrid*¹ Salts and Oils united together; and this Acrimony causes Thirst, Driness, Heat and Inflammation, stimulates the Solids, increases the Velocity of the Fluids, and dissipates the thinner Juices; whence the *Heart-burn*², a *burning*³ Pain in the Stomach, Sickness, *Belchings*⁴, *Vomitings*⁵, *Fevers*⁶, a Wasting of the Fat, a *Contraction*⁷ or Withering of the Limbs, and Diseases thence resulting.

¹ The Acrimony of Spices is very small in Quantity, and much resembles Fire; and even in a whole Pound of Pepper, there are not many Grains of that Oil and Salt which gives Acrimony to the Whole: For when the essential Oil is drawn off,

off, all the rest is an insipid woody Substance. But if from such an essential Oil you evaporate the spirituous Rector, or volatile saline Spirit, even that Oil will lose its Taste without suffering any sensible Diminution of its Weight; therefore that Part which is acrid in Spices, is a Spirit: And therefore it is no Wonder, that this so subtil an Acrimony should be capable of penetrating the Nerves, and burn up or destroy those tender Parts, if they are not conquered by our nervous Spirits. When a healthy Person eats Cinnamon, and continues that Practice of chewing it for some Years, he will not have one Tooth in his Head, for they will be all burnt up and destroyed as if by actual Fire: An Instance of which we see daily in those who deal in Spices. It is not without Reason, that *Sendivogius* seeks for the chemical Principles of a Body in its Archeus or Spirit; but when that Archeus which we take is more powerful than our own, we are then burnt up and destroyed by it. For Spices, like Fire, used in a small Quantity, are serviceable; but used too abundantly, they are destructive. *Bontekoe* recommends Spices as the Hand of the Gods; but there is no doubt that with those Medicines he has killed Numbers: For no Inflammation is more fatal than that raised by the distilled Oils of Spices.

² This Pain is seated in the left Orifice of the Stomach, which is by the Ancients termed *Cardia*, whence *Cardialgia*; but this may arise from different Causes. When a weak Person eats Rye Bread in great Plenty, and drinks Water after it, after a few Hours Time acid Belchings will follow, the Liquor rising into the Mouth being almost as sharp, and setting the Teeth on Edge like Aqua Fortis: But one who has taken a large Quantity of Pepper, will have a Heart-burn much worse than

the former, since the first may be easily cured merely by the Use of Crabs-eyes, or any other of the Testacea; but the latter can be relieved only by a large Quantity of Water.

³ I have myself experienced the intolerable Force of this Fire in my own Stomach.

⁴ Belchings follow, because those Spices which we call Carminatives, stimulate the solid Parts to Contraction, so as to expel the contained Air, or elastic Vapours, from the Stomach.

⁵ The Ancients rank Horse-radish among the most speedy Emetics; and therefore we may refer all Spices to the same Class, if they are taken in a very large Quantity: For if they are taken but in a moderate Quantity, they rather suppress vomiting.

⁶ A dropfical Person, who is above all others the most remote from Fever, will be afflicted with more than a slight Fever for several Hours, if he has drank Plenty of Wine with beaten Pepper.

⁷ The Nerves or Tendons become stiff and contracted, and their membranous Capsules are stuffed up; which Disorders we observe chiefly in the Hands and Feet, when the flexor Muscles being convulsed, prevail over the Extensors; which last becoming paralytic, yield to their Antagonists.

§. 762. A third Kind of Acrimony is spirituous, prepared by *Fermentation*¹, and improved by a long Continuance of it, or heightened to the last Degree by Distillation, residing for the most Part in Wines, Ale that has been long kept, and distilled Spirits. It produces Thirst, *Drunkenness*², Tremblings, spasmodic Constrictions and *Driness*³ of the Fibres, which therefore shrink or contract, a Coagulation

tion of the Humours hardly to be resolved ; a Stimulation and very quick Action of the solid Parts soon vanishing, so as to make it necessary to *repeat* ⁴ and increase the taking of the like Liquors ; whence follow Weakness, *Flatulencies* ⁵, Obstructions, Fevers, Tumors, Leucophlegmacy, *Dropsy* ⁶, and the like Disorders.

¹ Ale, Wine, and other vegetable Juices, after Fermentation, do by a Heat no greater than that of the human Blood, distil a pure Alcohol or inflammable Spirit ; concerning which *Lulli* says, I extract a Body which evaporates before the Fire without leaving any Residuum : And even the ancient Chemists have wrote concerning the Spirit of Wine and Barley, even long before *Basil Valentine* and *Paracelsus*. But it is from this Alcohol only that Drunkenness or Inebriation arises ; and the more this Spirit abounds in any Liquor, the more does it intoxicate. Strong Wine and Ale being exposed any Time to the Air, lose all their inebriating Power without any great Diminution of their Weight ; and then they are of no other Use but to cause Gripes, or the Strangury.

² If a Person used to a sober Life drinks more Wine than usual, he becomes brisker, his Wit seems to be sharper, and his Judgment more ready and fluent ; but if he drinks still more, he begins to grow delirious, flutters, and becomes at length raving or stupid. Thus in the Fable, *Bacchus* converts all into Beasts, who were in the same Ship with him. At last he becomes paralytic, his Limbs being incapable of their Office of supporting him, till Sleep puts an End to the Disorders, unless the drunken Fit should have first induced a fatal Apoplexy.

³ From

³ From hence arise numerous Diseases of the Brain and Nerves.

⁴ That they may always keep their Vessels inflated with the Wine drank the Day before, without which Continuance the Head shakes, and the Limbs tremble; for the Brain is much weakened by the perpetual Use of inebriating Liquors. Thus by inducing a short Flow of Spirits, People are drawn aside by these Liquors even to their Destruction.

⁵ They who have been fuddled, are the next Morning subject to Flatulencies, and bring up a cold Water and Phlegm from their Stomach, which invites them to redress the Evil by drinking again. They who have been addicted to the Use of Opium in *Asia*, fall into the most lamentable Melancholy and Lowness of Spirits, if they are by any Accident deprived of the beloved Poison; insomuch that they sell all they have to buy Opium, or at last relieve themselves by the Halter. If indeed they can supply the Place of Opium with strong black *Cretic* Wine, that may produce the same Effects with Opium. To all this *Prosper Alpinus* has been an Eye-witness.

⁶ At the End come Dropsies, and at last Death itself.

§. 763. There is, lastly, a fourth Kind of penetrating and fermenting Acrimony, which is found chiefly in the unfermented Must or Juices expressed from ripe Fruits, new Wine or Ale, suddenly *closed up* from the Air in the Beginning of the Fermentation, which is thus suppressed; and this Acrimony creates Belchings, Flatulencies, convulsive Motions of the Stomach and Intestines, Vomiting, Cholera

Cholera Morbus, Diarrhæas, Dyfenteries, iliac Passion, and the like.

No one would imagine what a small Quantity of a Vapour can kill a Person. In the Fermentation of any vegetable Juices, they discharge spirituous and acid Particles which are extremely active, and affect the Nose with a pleasing Smell: And this is the Gas of *Helmont*, which is not to be found in Liquors already fermented, but only in those which are advancing in the Act of Fermentation itself. But if these Vapours are inspired plentifully at one Instant into the Lungs, they immediately suffocate; but if they are drawn in a less Quantity, they give an Apoplexy; and in a less Proportion, they cause a Stuttering. There is, perhaps, no Principle so active throughout the whole Universe, as that which exhales from vegetable Juices in the Act of Fermentation. When there are a Thousand Pints of Must or new Wine close shut up in a Cask, only a small Pin Hole being left open, the Liquor now fermenting violently, if any one then applies his Nose to the Vent-hole, and breathes in the Vapour, he will immediately fall down dead or suffocated. Hence bottled Ale and other Liquors, in which the Fermentation has been suppressed, so as to make them fly up into the Air upon drawing out the Cork, are very unwholsome, not only by exerting their Elasticity or expansive Force in the Stomach and Intestines, so as to cause Flatulences, Cholics, &c. but they likewise exert the same Force in a proportionable Degree in the Blood itself, and the Juices derived from it; whence Head-achs, Fevers, Tremblings, and other nervous Disorders. In the Memoirs of the Royal Academy of Sciences, we have an Instance of a certain Nobleman, who
being

being very thirsty, drank a large Quantity of very strong Ale which had been stopped up close in a Pitcher, and not yet perfectly fermented; but this Person perished, notwithstanding all the Endeavours of Physicians; and upon opening the Body, the Intestines were found distended with Flatus to a Degree more than credible; for the acrid Gas of the fermenting Ale being excited into Action by the Heat of the Stomach, produced Convulsions, which admitted of no Relief from all the Assistances of Art.—I do not in this Place consider more of the Species of Acrimony, since my Design here is to treat of such only as are admitted with the Aliments into the Body.

§. 764. Too much Viscidity or Glutinosity of the Food prepared from mealy Substances not fermented, or from the gelatinous Parts of Animals, and dry Cheese or tough Curds too much hardened or pressed together, occasions a *Weight* ¹ in the Stomach, *Flatulencies* ², Belchings, Acrimony or Heart-burns, Crudities, *Obstructions* ³ of the smaller Vessels in the Intestines, and from thence a Constipation or Sluggishness in the Motion of the Bowels, with a *Tumor* ⁴ and Hardness of the distended Abdomen; and in the next Place, the Blood itself is infected with the like Viscidity from the glutinous Particles of the Aliment *uniting again* ⁵ into a ropy Matter like Bird-lime, whence Obstructions of the *Glands* ⁶, Paleness of the Skin, Weakness, Coldness and Swelling of the whole Habit; whence it is evident, that they produce the same Effects with those Things which are called *potentially* ⁷ cold; and

and that they are more especially injurious to *idle* ^s People, or those not addicted to bodily Exercise.

¹ For these Substances are not transmitted thro' the Pylorus before they have acquired a fluid State. For if viscid Aliments were to be transmitted into the Intestines, in the same Condition as we receive them into the Stomach, we should have been liable to a much greater Number of Disorders. From this Retention therefore of the viscid Mass in the Stomach, to the fourth, or even to the eighth Hour after a Meal, arises a Heaviness, and uneasy Sense.

² The Flatus proceeds from retaining the Air; for the Tract of the Intestines in a healthy Person is quite closed both above and below, as is evident from Clysters, which are often entirely retained without the Discharge of one Drop.

³ Obstructions arise from a stuffing up, or Infarction of the bibulous Vessels.

⁴ Such a Tumor as often appears in Infants; from the Milk and thick Curd, upon which only they are nourished, or from the crude and tough Paste which is made for them of Bread and Water, not being superable by the weak digestive Powers of the Infant: And after a While, this Distension of their Abdomen goes off with a Looseness, the Intestines become turgid with Flatus, and at length transmit every Thing unaltered, whence an Atrophy, and Death itself. The Cause consists in the Weakness of the Bile, which is not capable of overcoming or attenuating the tough phlegmatic Mass of the Chyle; and in this Case, I recommend Frictions, with rough and warm Cloths to be made before the Fire every Morning and Evening, which has happily recovered many: Whereas,

if

if you attempt to relieve the Infant by purging, the Pituita, or phlegmatic Mass, will be renewed continually.

⁵ Nature has used many Precautions to prevent any gross Matter from entering the Veins so as to pass to the Liver from the Intestines. But no one Particle of the Aliment is of itself viscid, unless it be joined with another, and then they mutually attract each other. Thus one Particle of Starch is not like Paste, but passes through a Sieve made of the finest Lawn, whose Pores are extremely minute; but if now Water be added to these Particles of Meal, they then form a ductile Paste, which may be extended betwixt the Fingers, and will again contract itself. When therefore two or more viscid Particles pass by themselves into the lacteal Veins, and afterwards meet together in the thoracic Duct, or in the Vena Cava to the Heart, through all which Tract the viscid Particles of the Chyle mixing with the venal Blood, may cohere and run together; in that Case, Viscidities will arise, the Effects of which will first manifest themselves in the Lungs. Hence *Malpighi* justly observes, that the most healthy Person eating too much Beans, Pease, or other farinaceous Food, will in a few Hours after the Meal, be troubled with a short Peripneumony. One who eats a large Quantity of Beans will be troubled with an Asthma from the third to the sixth Hour after the Meal, nor will he be able to run at that Time, or perform any other Exercise; but when the Lungs have overcome and freed themselves from the viscid Matter, the Person will be again at Liberty to breathe freely, and perform the usual Exercises of the Body; and from this Observation alone it is sufficiently manifest, that the viscid Parts of the Aliment pass into the Blood.

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⁶ The Effects of viscid Matter sent into the Blood, are strumous Swellings of the Glands, more especially of the Parotids with the thyroide, maxillary, submaxillary, and inguinal Glands, but above all of the mesenteric Glands, to which the Chyle is first conveyed; and last of all a Paleness throughout the whole Body.

⁷ That is, such Things as being applied to, or taken into the Body, occasion it to be colder than it otherwise would be without them. All Bodies surrounded with the same Air are equally cold, whether they be the softest Feathers, the hottest Spices or Spirits, or even Ice, Mercury, or Snow; for all these contained in the same Air, manifest the same Degree of Heat by the Thermometer, as I have demonstrated more at large in my chemical Lectures upon Fire. But there are certain Bodies, as Pepper, &c. which manifestly increase the Heat of living Animals, but produce no such Effect upon dead Bodies; and therefore Pepper, Brandy, &c. though not actually hot in themselves, are said to be so potentially with regard to their Effects upon the living Animal. In the same Manner a Thing is said to be potentially cold, even though it be actually warm, if the Application of it to the living Body diminishes the Cause of animal Heat, and, consequently, renders the Body cooler. If the strongest Youth, whose Blood is very warm, should continue to drink nothing but warm Water for the Space of eight Days together, he will be reduced almost to a Coldness which may be destructive; and therefore actually warm is potentially cold, with respect to its Effects upon the living Animal.

⁸ Crude and pituitary Aliments afford the best Nourishment for People addicted to mechanic Labour; but the same Aliment would be extremely pre-

prejudicial to sedentary People, while the thinner Aliments which are most agreeable to these last who use no Exercise, would be prejudicial to labouring People. If you feed a Ploughman with Broth, he will faint under his Exercise; but if you give him Bacon and Bread, his Strength will be recruited and supported: But the reverse obtains with respect to a sedentary Person, or a Man of Letters.

§. 765. Too much Oiliness in the Aliments, lubricates, *relaxes*¹, and weakens the Solids, *obstructs*² the Mouths of the smallest Vessels, and hinders the watery Humours from entering into and passing through them, prevents the due Mixture of the Humours, and infects them with a rancid and *caustic*³ Acrimony; from hence follow Belchings, Sickness, and Vomiting of an *oily*⁴ Bitter, and a *rancid*⁵ Matter, intense Thirst, Obstructions, *Inflammations*⁶, Indigestions of the Viscera, and the Disorders from thence following.

¹ This is evident in a Piece of Leather, which though incapable of being bent or cut while dry, becomes easily flexible into any Figure without cracking, after it has been macerated in hot Oil. The same Effect have Oils in the human Body, and given at proper Times; they are a good Medicine: But a too plentiful or continual Use of them occasions particular Diseases. The Monks are obliged by their Religion to abstain from Bacon and the Fat of Animals, instead of which they use Oil to fry their Meat; and therefore in the Convents of Monks, you will most frequently meet with the Disorders proceeding from too much

Oiliness of the Food, and in no People do we observe inguinal and scrotal Herniæ more frequent than in these.

² Almost all the thinner Humours of the human Body are not oily, but in a Manner saponaceous; but Water will not pass through a Paper which has been first dipped in Oil, nor will Oil distil through a Paper moistened with Water. Therefore when Oil penetrates to the smallest Vessels of the Body, it obstructs them with respect to the thinner Humours, as is manifest enough in People of a weak and tender Habit; for in such a Person an Erysipelas will follow after rubbing any Part of the Skin with Oil.

³ Nothing is capable of a stronger Acrimony than Oil. The Fat of Veal is in itself a most inoffensive Body, but when it has been fried over the Fire for some Hours, it becomes so black, bitter, and caustic, that the least Part of it taken into the Body, excites a Fever.

⁴ Nothing is sweeter than Butter lately churned, or Oil of Almonds soon after it has been expressed; yet these being retained too long upon a weak Stomach, acquire an intolerable Rankness and Acrimony. When a Person has eat a great Quantity of Butter at his Breakfast or Dinner, without tempering it with a due Proportion of other Food, he will in six, seven, eight, or nine Hours after, be troubled with Belchings, which will bring up a bitter, rancid, and abominable Oil into his Mouth, which will at the same Time feel caustic, excite an Inflammation in the Fauces, and leave an intolerable Taste upon the Tongue.

⁵ You may frequently hear People exclaiming against Oil or fat Meats, that they cannot endure them, because, as they tell us, of their turning into Bile, which is an improper Phrase to express the

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Belchings of a rancid and bitter Oil ; for Oil and fat Substances are the least offensive to those who have a strong Bile ; whereas in those who have a weak or but little Bile, oily Substances degenerate into a spontaneous Rancidity.

⁶ Fat People, above all others, more frequently perish, or are the most severely injured by Fevers and Inflammations ; for in these People the stagnating Oil or Fat is dissolved, and by the increased Motion and Heat becomes rank, bitter, and irritating to the Solids, so that no other Cause can produce worse Disorders than what *Hippocrates* himself has observed to proceed in this Manner from the Oil or Fat.

§. 766. Too much Motion of the Muscles throughout the whole Body, or in some particular Part, always increases the reciprocal Contractions and Relaxations of the muscular Fibres, and at the same Time accelerates the Motion of all the *Humours* ¹ ; hence the Solids and Fluids suffering too great Attrition, are dissolved, the most subtil, watery, and spirituous Parts are dissipated, while the remaining Parts of the Humours acquire an inflammatory *Thickness* ² ; in the mean Time the oily and saline Parts are too much attenuated, ground together, *volatilized* ³, and exalted, as it were, into a putrid Acrimony, the more thick or tenacious oily Parts are accumulated or left behind, and the Humours are, in a Manner, rendered *adust* ⁴, more especially the *Bile* ⁵ ; the *Medulla* ⁶ itself is consumed, and the Cells which before contained Fat, are now filled with Ichor or sharp Lymph,

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Lymph, whence Leanness, *Weariness*⁷, Pain, Inflammation, Fever, Suppuration, Gangrene, *Hæmorrhages*⁸, and sudden *Death*⁹.

¹ A Muscle cannot contract or relax itself reciprocally, without increasing the Motion of the Blood towards the Heart, which will be thus urged to a more frequent Action, by the Blood being accelerated through the Veins to the right Ventricle, whence the Respiration and Pulse will become more quick and frequent, so that a severe Fever may arise barely from muscular Motion, by Excess in which, continued for the Space of but one Hour, may follow a Fever no less acute than the Plague itself.

² Men who have brought upon themselves Diseases by running and over Exercise, can hardly be bled, even by opening one of the largest Veins by the Lancet, so thick is the Blood, and so apt to concrete into a coriaceous Mass, as in Pleurifies. Even the same Person who has discharged good Blood by Phlebotomy, will, after one Hour's violent Exercise, have his Blood covered with a pleuritic Crust. The same Thing happens in acute Fevers, in which the Blood becomes too thick and viscid from a too violent Circulation.

³ In Proportion to the Degree of Heat in the Animal, will be the Degree of Acrimony and Putrefaction in the oily and saline Parts of the Humours; and from hence arises the fetid or strong Smell of all Animals addicted to hard Labour. A healthy Person fatigued with running, tinges the Linen with a yellow coloured and strong smelling Sweat, when by Rest or moderate Exercise, inodorous and watery Vapours only would be perspired from the Skin; and therefore Motion alone renders our Humours acrimonious. This I

have experienced in myself, when I have walked all Night long in searching after Plants to complete my botanical Studies; but resting myself in the Morning, I have been surprized to see my Linen stained with a fetid and yellow Sweat. Horses sweat when they run, and if that Sweat is formed into Pills and given to a Dog, he will be troubled with a rumbling in the Bowels, and breaking of Wind both ways.

* The Term of Aduſt, which was introduced by the Ancients, ought not to be exploded; for if you compare the Blood of a Person which has been designedly dried at the Fire, with the Blood of a Man extinguished by an ardent Fever, you will find that the Blood in both Cases is thick, gross, black, tenacious, and almost capable of being divided by the Knife. The Blood in a Pleurisy, Phrenzy, or ardent Fever, is so thick, that it is scarce capable of moving, but instantly congeals into a solid Mass as soon as it is drawn from a Vein into a Basin.

5 The Bile is of all Humours in the Animal Body most inclined to a spontaneous alkaline Acrimony, and that even in the strongest Degree, as it is naturally the most acrid Humour in the Animal; and if in this putrid State the Bile is absorbed, either by the sanguiferous or lacteal Veins, it liquifies and dissolves the whole Mass of the Humours.

6 It is well known, that too much Exercise consumes the Fat. The most fat Horse being by Degrees brought to Exercise, may, in the Space of ten Days Time, be reduced as lean as a Skeleton; and Oxen killed, after they have travelled a long Way, are not only lean in their Flesh, but have also no Marrow in their Bones; in the Cavities of which we find a thin, red-coloured, and watery Ichor;

Ichor; all the Fat having been before dissolved, returned into the Blood and discharged by the Emunctories. It is an Experiment of *Du Verney* made at *Paris*, that when Oxen are killed there, immediately after they have been brought three or four Days Journey out of the Country, instead of Marrow they find the Bones filled with a yellow Ichor; but if they are first suffered to rest and feed a few Days in the Suburbs, the Marrow then returns again into the Bones.

⁷ Weakness and Weariness of the Joints proceed from a Consumption of the Oil, which ought to lubricate the Ligaments.

⁸ These Hæmorrhages are good and salutary, unless they should be determined to the Nose or Kidneys.

⁹ The most violent local or muscular Motion may in one Hour produce the same Effects with a severe Plague. There are an infinite number of Horses which die suddenly, when having been educated in Idleness, they are upon some occasion urged to violent running. The celebrated *Ruyseb* at the *Hague* observed 70 Years before his Death, that in a Horse perishing from this Cause, there were several Pounds of mere Oil extravasated into the Cavity of the Abdomen.

§. 767. But if too much Exercise or Motion of the Muscles, should happen to *cachymical*¹ or consumptive People, who have any of their Viscera unsound, and especially in very hot Weather, they will be subject to sudden *Death*².

¹ When atrabiliary People undertake long Jour-
nies, or fatiguing Exercises in the Summer time,

then the Atrabilis is put in Motion, dissolved, and translated to the more important Viscera, whereupon follow severe Gripes, Vomitings, atrabilious Diarrhæas, &c. There was a melancholy Gentleman of this City of *Leyden*, who by wrong Counsel went a Journey on Foot to the *Hague* in Summer-time, when he might have gone in his Chariot; but by the Way he was taken so ill, that he could go no farther, and believed that he should die; because the Atrabilis being fused, took its Course downward; but by good Luck he had some Oranges about him, which he devoured, and was by that means enabled to complete his Journey, and is still living: But he told me, if it was not for the Oranges, he should certainly have died.

² Frequently when a Physician advises a caco-chymical Person to Exercise or muscular Motion, and the Patient inadvertently takes his Advice, sudden Death has been known to follow, or at least a Dropsy, Empyema, or some other consumptive Disorder: You ought therefore to be cautious of giving such Advice to a Patient. There have been some acquainted with the Benefit of riding in Consumptions, who have immediately mounted and addicted themselves to violent Exercise of Body, so that the venal Blood being violently moved, has overcharged the small Portion of the Lungs yet remaining, and they have suddenly perished. Muscular Motion, or Exercise, is therefore not convenient for those who have any of the Viscera unsound; but Exercise is more especially injurious to such in hot Weather; for then even the most healthy Animal may be in Danger of Life, from too violent Exercise in so hot an Air.

§. 768. Too little Sleep or *over-watching* consumes the *Spirits*², which can no other-wise

wife be repaired than by Sleep; it dries up the other Humours, *wears out*³ the minuteſt Solids, eſpecially thoſe of the Brain, and increaſes Acrimony, obſtructs the digeſtive Powers and *Nutrition*⁴, exaſperates the *Bile*⁵, and by theſe means occasions *Leanness*⁶, Fevers, Delirium, generates *Atrabilis*⁷, which is either ſtirred up or evacuated; together with the innumerable bad Conſequences following from thence, Sorrowfulneſs, a depraved Imagination, continual *Reſtleſſneſs*⁸, &c.

¹ In Vigilance there is a perpetual Exerciſe of Motion in the Muſcles, and a Conſumption of the Spirits.

² Which are generated in the Brain, and operate in the Nerves; but this Liquor can be repaired by no other means than by Sleep. The tired Ploughman has his Strength recruited, ſo as to fit him for the next Day's Labour, only by ſound ſleeping in the Night.

³ Since there is a perpetual Motion in the very ſmall Veſſels of the Brain, the Solids and Fluids muſt neceſſarily rub againſt each other, and conſequently wear away and deſtroy one another.

⁴ Nutrition is in thoſe Veſſels which convey the nervous Spirits to the Brain.

⁵ The Bile is tempered, digeſted and rendered milder by Sleep.

⁶ Sleep conduces more to make People fat than any one thing beſides; and all Animals will continue lean, though you feed them ever ſo much, if they are deprived of their due Sleep.

⁷ I have myſelf obſerved a prodigious Quantity of Atrabilis diſcharged after watching has been too long continued; but it ariſes from the remain-

ing groffer Part of the Humours, after the more fluid Parts have been diffipated and destroyed.

⁸ Restlessness, together with nervous Disorders. I have accurately experienced the Truth of this Aphorism in myself. When a Person is too much taken up with Meditation, there is a surprizing Readiness of the Faculties towards all the Functions of the Mind, which is followed afterwards with an Inability of Sleeping, and then the Nerves are afflicted with severe Pains, not easily removed but by a prudent Treatment. This I have experienced in myself in the Year 1732, when I have imprudently meditated too much upon some Affairs, from early in the Morning, till Sun-set at Night; but for six Weeks after this I could get no Sleep, either by Day or Night; awake indeed, but with a sort of Indifferency to every thing which did not affect me as usual. After this followed Pains of the whole Body, as a Token that the Spirits were deficient, which ought to repair the Vessels, and diffuse themselves throughout the Body.

§. 769. Too much Rest or Inactivity of the *Muscles*¹ throughout the Body, or in some particular Part, renders the muscular Fibres unfit for Motion, diminishes the *Velocity*² or Motion of all the Humours, and therefore disposes them and their constituent Principles to *Concretion*³, Inspissation and Inactivity, whence follows a *Repletion*⁴ of the *Cells*⁵, an Accumulation of the Fat and Medulla, whence Corpulency, Coldness, *Dulness*⁶, Laziness, and Stupidity. From hence therefore we may understand the Effects of an idle and sedentary *Life*⁷.

¹ The Heart is a Muscle which never rests from its Action, being formed by the Creator for perpetual Motion, to which it may be even recalled by the Asperſion of Water in a Palsy of it or after Death. But any Muscle which has lain too long unactive and at reſt, is rendered unfit for Motion. When the Cubitus or Radius is fractured, and the Arm is carried in a Sling ſuſpended without Motion for a whole Month, upon removing the Dreſſings at the Length of that time, the whole Limb is ſometimes found contracted in its Length and immoveable; becauſe all Fibres left to themſelves contract and ſhorten by mutual Attraction and Approximation of their conſtituent Particles cloſer to each other; but by extending the Limb, it becomes by degrees more flexible, as the conſtituent Particles or Elements of the Fibres more eaſily recede from each other; but ſo ſoon as the elementary Particles are perfectly removed from their Contact, there is then a Rupture. Suppoſe we have a Body which is required to be made very flexible, we then alternately bend and extend it, as Gardeners do Trees, when they are willing to bend them into any Figure. But when the elementary Particles are left to themſelves, they mutually attract each other, and gradually increaſe their Cohesion, ſo that they cannot eaſily be diſtended by the Fluids; whence the Fibres become unfit for Motion, becauſe there is no Motion but by a Repletion of the Fibres with the nervous Juice.

² Becauſe the Motion of the Humours is committed only to the Strength of the Heart and Arteries.

³ We live and are nourished by Solids ſubtilized by Attrition, for thus we may better call them than by the Name of Fluids; for the animal Fluids are nothing more than Solids ground fine,
and

and kept separated from each other by the grinding Machine of the Circulation, so as to have the Appearance of Fluids ; hence when Drops of Blood distil from the Nose by the resting of the Particles they unite together into a solid Mass.

⁴ When the Humours are drove by the Force of the Heart, without any Force of the Muscles, the red Blood indeed passes through the Arteries into the sanguiferous Veins, an Obstruction of which would be Death ; but the Serum of the Blood, though propelled into its Arteries, will yet not find its way through the serous Veins, for want of the Assistance of muscular Motion to urge it forward ; and the like Defect will take place also in the other Series of Vessels. Since therefore the most fluid Parts of the Humours only will escape into the lateral Vessels, therefore the Humours will stagnate in the smaller Series of Vessels, and continue there to be accumulated, until all the more fluid Parts are drained off from the Mass of Blood, which will therefore become thick and impervious for want of the Return of the more subtle Juices.

⁵ Which Cells will be filled in proportion as the Humours lessen in the larger Vessels ; for so soon as muscular Motion ceases, the Cells fill up and the Person becomes fat or corpulent. In a fat Ox the Vessels are smaller than in a lean one, as being compressed by the Cells expanded with fat.

⁶ Turn to the Instance before-mentioned at §. 593. N°. 8. of a Physician who by accustoming himself to a Habit of sleeping, at length became quite stupid in his Faculties, and perished in a public Hospital.

⁷ The way to long Life is Moderation, betwixt too much and too little Exercise of Body, so that it may not be wore away too much by Labour,

bour, nor yet overloaded with Oil or Fat; by which Medium Life may be spun out to its utmost Extent.

§. 770. Too much Sleep dissipates and consumes the more volatile or fluid Parts of the Humours, gradually inspissates the rest, and accumulates them together in the smaller lateral Vessels, where they almost stagnate with little or no *Motion*¹, hardens the *excrementitious*² Parts, and occasions them to be retained, causes an Heaviness of the *Brain*³, a Repletion of the Head, and a *Dulness*⁴ of Sense and Motion; whence follow nearly the same Effects as mentioned before (§. 768.), and is therefore the most prejudicial to those who are most *inclined*⁵ to it, but may be serviceable to such as seem inclined to over-watching.

¹ The *Sanctorian* Perspiration after natural Sleep, which in a healthy Person not fatigued is about seven or eight Hours, expels from the Body the most thin Humours, so that if it be continued longer, all the thinner Juices will perspire, and the remaining Juices will be inspissated, returning more slowly by the Veins, and hardly at all from the lateral Vessels; whence the Oil will be conveyed through the lateral Vessels opening into the Cells from the Blood. If a Person sleeps with his Legs and Thighs hanging down, they will be oedematous or swelled; but if the Person walks, the Swelling will be removed by the Motion of the Muscles compressing and emptying the small lateral Vessels and Cells, in which the Humours were collected.

² Because these are not discharged in Sleep. A Person who is waking hardly retains one third of the Urine, as is often received into the Bladder without Uneasiness in a Person sleeping: and the same is also true with regard to the intestinal Fæces; and therefore all the grosser Fæces are retained in Sleep.

³ All Animals sleep, not excepting even Fish. But it seems from considering the Fabric of the Brain in Man and brute Animals, that the Circulation of the Blood is carried on only in the Pia Mater and larger Vessels of the Brain, while the rest of the Cortex is at rest, and the Blood making a short Course, returns through the Sinuses. Hence the Brain seems to be in a manner collapsed in Sleep; and that Sleep then arises when the Cortex of the Brain is so compressed, that the Cavity in the cortical Vessels is destroyed, whether that Compression arose from a Repletion of the Ventricles of the Brain distended with Lymph, or from any other external compressing Cause, or from a Collapsion of the Brain itself.

⁴ This is well observed by *Celsus*, in treating concerning Repletion of the Brain, following from too much Sleep: and there is no one but what must be sensible of a Dulness in themselves when they have slept longer than usual; as for Instance, above ten Hours. For such a Person will find his Senses dull, and a Heaviness in his Head; because at that time the venal Blood is accumulated in the Brain, while the smaller Vessels are collapsed; which venal Blood will return again towards the Heart, when the Arteries have recovered their former Strength.

⁵ For such ought to keep themselves awake; but those who are too watchful, and sensible of a kind of Chearfulness which drives off Sleep, such ought

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ought to encourage it, or even procure Sleep by Art; for Contraries are always salutary in these Disorders of the Appetites, except in Sleepiness arising from an inflammatory State of the Brain.

§. 771. *Violent*¹ Passions of the *Mind*², or a too long *Continuance*³ of them, wonderfully and powerfully *alter*⁴, dull, and deprave the Brain, Nerves, Spirits, and Muscles; so that they may be able to produce and increase almost every Kind of Disease, according to the different Kinds and Continuance of the Passions.

¹ Which suddenly transform a Person, as it were, into a Statue, resembling a true Catalepsy. I knew a healthy Prime Minister to a certain Court, who while extremely intimate in the Favour of his Prince, gave an Account of some Things not just; but afterwards his Prince walking towards him, ordered him to depart who had deceived him. Immediately from that Time the Courtier perceived an Uneasiness and Weight in his Breast, and three Days after expired. Nothing is more commonly known, than that the Fæces are often discharged involuntarily by a Fright.

² Passions of the Mind are violent Motions of the Will, nor is there any other Cause which so much disturbs our Thoughts. But the Series of our Thoughts is in the common Sensory, which is in all that Part of the Brain connecting the Cortex and Medulla together; and therefore the Passions of the Mind exert their Force upon the Brain, and determine the Spirits to move more swiftly towards the Muscles; but variously agitate the Spirits returning from the Organs of Sense, to the
common

common Sensory. Sometimes they fix Ideas so strongly, that they cannot be effaced; and I have myself experienced, that the Memory of Quarrels cannot be suppressed, notwithstanding all our Endeavours, nor can a Person lay those Thoughts asleep; which is also true with respect to Envy and Revenge. But so soon as other Ideas arise in the common Sensory, those displeasing Thoughts are weakened, and in a great measure removed.

³ Such as produce the same Effects in a Succession of Time, which Effects follow suddenly one after another.

⁴ If a tender-hearted Person sees some cruel Operation, such a Person often faints and looks like one dead. It is easy to conceive, that if Fear can suddenly induce the Face of Death in the Body externally, it must also produce extraordinary Changes in the Viscera internally.

§. 772. Spitting away too much of the Saliva, disturbs the primary and subsequent *Concoction*¹, that it depraves Digestion in the Stomach and Intestines, as well as in the chyloferous and sanguiferous Vessels; occasions Thirst and Driness, wasting of the Habit and Loss of Nourishment, generates *Atrabilis*²: Or if it is not at all discharged into the Mouth, or in less Quantity than usual, it impedes Mastication of the Food, hinders the Taste, Deglutition, and Digestion, and at the same Time increases Thirst.

¹ *Drelincourt* well observes, that the Saliva being swallowed and mixed a second Time with the Blood, returns again to the Glands, and is cohabated in an improved State upon the Aliment, to which

which it proves a perfect Menstruum. There is certainly no Humour more healthy in the Body; for being swallowed, it cleanses the empty Stomach, scours off the Mucus by its saponaceous Force, and at the Time of Digestion dissolves the Food, and promotes the Assimilation of it. When the Saliva therefore is deficient, the Digestion is depraved in the Primæ Viæ, which cannot be corrected by any other digestive Power in the Viscera, though at the same Time Defects in the other Concoctions may be corrected by perfecting the first. This Subject has been well handled by *Pyerus*, in his Treatise *De Ruminantibus*.

² An old *Spanish* Physician, from whom I learnt many Things, informed me, that the Physicians having ordered the Prince some Pastils of Mastick and odoriferous Things, to correct his Breath, which stunk very much, in a little Time it became a Fashion throughout the whole Court, so that not one of the Nobility was to be seen without chewing the like Pastils in their Mouth. But from this Cause the whole Court was disordered with atrabiliary Distempers; since by spitting away too much of the Saliva, the thinner Juices being consumed, the remaining Humours became too thick and viscid, so that none of the Court escaped from hypochondriacal Disorders, with a Depravity of the Mind, except those only who were of a very succulent Habit; but the Cause of this Disorder being discovered, both the Use of Masticatories and the Disorder itself vanish together. *Hippocrates* of old has observed, that those who spit much, either are or will become melancholy. They who smoke too much Tobacco, exhaust the Body of its laudable Juices, bring on Weakness, a bad Digestion, Driness of the Membranes, Leanness, Thirst, Consumption, and at last precipitate themselves

selves into a Melancholy, except they are of a phlegmatic Habit. When an Army was marched through the Desarts of *Asia*, the Soldiers were supplied with Quids made of the Leaves of Tobacco, by chewing which they might take off their Hunger; and thus indeed their Hunger was suppressed, but the whole Body was at the same Time exhausted. They who have often undergone a Salivation, usually fall into Melancholy.

§. 773. Too great a *Discharge* ¹ of the Bile either upward or downward, robs the Aliment of the chief Instrument employed in Chylification; hence the Digestion is depraved, the Separation of the Chyle is obstructed, and the Expulsion of the Fæces retarded; it therefore produces an *acid* ² Temperature of the Juices, *Coldness* ³, Weakness, Paleness, Leucophlegmacy, and Faintings. But if the *Bile* ⁴ being once formed, is prevented from flowing into the Cavity of the Intestine, it creates a Jaundice, together with the preceding Maladies.

¹ They who have a Deficiency of the Bile, are subject to a Swelling of the Abdomen. The Truth of this is evident in young Children, and in cachectic Virgins, where there is a Paleness, Coldness, Weakness, limpid Urine, Leucophlegmacy, and often Faintings.

² For all those Offices cease which were before ascribed to the Bile at §. 99, and 100. The Usefulness of the Bile has been rightly asserted by *Helmont* in Opposition to the Schools; for he has de-

demonstrated, that as soon as the Bile is deficient, the Formation of the Chyle must be impaired with the Assimilation of the Aliments, and all the Actions which have any Dependence thereupon.

³ When the Bile over abounds in but a small Quantity, a Heat arises in the Body; whence the Saying of the Ancients is not ill grounded, that from Bile arises Heat, and from Phlegm Coldness. If a Wound be made in the Gall-Bladder, by cutting it with a Pair of Scissars in a living Animal, Death follows, from an Extravasation of the Bile into the Cavity of the Abdomen. The same also appeared in a Man whose Gall-Bladder was run through by a Sword; for in three Days after he died convulsed.

⁴ In Vessels which are destitute of Valves, the Humours are easily determined that Way where there is the least Resistance, whenever any Resistance is increased on one Side; and therefore if a small Stone should stick in the biliary Duct, an Accumulation of Bile would follow throughout the whole System of the Liver, and then would follow Anxieties and intense Vomitings, in which, by the Pressure of the abdominal Muscles and incumbent Diaphragm, the retained Bile may be drove back through the biliary Tubes into the Blood of the Vena Cava, with which passing throughout the whole Body, it will produce a Jaundice, whereupon the painful Symptoms will become more remiss. Healthy Blood is of a dense or compact Texture, so that being received from a Vein into a Cup, it concretes into a Mass; but so soon as the Bile returns into the Mass of Blood, it dissolves the globular Texture, by its saponaceous Force, so as to produce a biliary Cacochymy of the Blood, manifesting itself in a Jaundice; in which Disorder, upon opening a Vein, the Blood drawn

from thence has but little Cohesion, and the Urine itself is so yellow, that it tinges a Piece of Paper or Linen of the same Colour. Thus the Bile has nearly the same Effect upon the Blood as Mercury, so that when the Disorder is far advanced, the Blood escapes from the sanguiferous into the smaller lateral Vessels, where stagnating, it produces a Dropsy, which after an obstinate Jaundice does usually precede Death.

§. 774. The lymphatic Juice of the Pancreas and Intestines too plentifully *evacuated*¹ from the Bowels, produces the like Disorders, with too great a Consumption of the Saliva (§. 772.), besides which it also occasions *serous*² Diarrhæas, whence extreme Weakness, Faintings, Driness of the Body, Thirst, hectic Fever and wasting of the whole Habit, termed a Marasmus. But if these Juices are not at all discharged into the Intestines, or if they flow in too small a Quantity, there follows too great a *Thickness*³ of the alimentary Mass in the Intestines, a Constipation of the Fæces, a Weight, Fulness, Gripes, *Twisting*⁴, or rather an Introversion of the Guts, Thirst, Fever, *Costiveness*⁵, Tumors, &c.

¹ There are some People who have a very plentiful Discharge of the Saliva into the Mouth, but then they swallow it all; and the same People have likewise a copious Discharge of the pancreatic Juice, which filling the Duodenum, regurgitates from thence into the Stomach, whence these People are used to complain of a Water abounding in their Stomach, especially in a Morning
fasting,

fasting, for after they have taken Food, they are better, because these Juices mixing with the Aliments, descend through the Intestines, and are discharged by the Anus. Nor is it any Thing surprising to meet with serous Diarrhæas in such People.

² Of an ash or a grey Colour, which the *Dutch* fear nothing less than the Plague. In this Disorder the Juices of the Pancreas, Liver, mesenteric Arteries, and Saliva which is swallowed, all pass out by Stool, from whence ensues extreme Weakness. For the Patient can hardly bear four of these serous Discharges without fainting; from hence proceed Convulsions, because the Humours are no longer capable of continuing their Course through the Vessels; for an incredible Quantity of Humours this way escape from the Bowels; and from thence follows a Driness, continual Thirst, hectic Fever, and Marasmus. Hence appears the Error of the common People who recommend or think well of a Diarrhæa in all Cases, as if it discharged the Matter of the Disease; whereas in this Case, a Diarrhæa exhausts the whole Body of its laudable Juices, and occasions a certain Atrophy or wasting of the Whole.

³ The Chyle is formed in the Stomach from solid Food, where the grosser Parts are retained, while the more fluid are expressed in the Form of Milk; but this Chyle has its more fluid Parts drawn off and absorbed by the Lacteals, as it passes along through the Intestines; and yet the Fæces appear no less fluid at the End of the Ileum than at the Pylorus. From hence it follows, that as much Juices must be conveyed to the alimentary Mass from the Arteries into the Intestines, or that there must be a Quantity of the salival and gastric Juices supplied equal to what is absorbed by

the lacteal Veins; but if this Afflux of the salival Juices is diminished or suppressed, the remaining gross or excrementitious Parts of the Food must of Necessity become thicker, and move on more slowly. Sometimes this Disorder happens in Children, in which there is a Swelling of the Abdomen, and after Death all the large Intestines are found distended with Fæces.

⁴ There was an old Woman here at *Leyden*, who expired of a Vomiting of her Fæces; but upon opening the Body, a Portion of the indurated Fæces appeared to be concreted to the Sides of the Intestinum Ileum, which being an incurable Case, the Patient's Death was unavoidable.

⁵ Hence it is, that the most healthy and strong Men are most frequently subject to the Piles; for the hard, rough, and abounding Fæces, are not capable of moving forward, but by straining almost like a Woman in Labour; by that straining, the Rectum is compressed, and the Course of the arterial Blood promoted, while that in the Veins is retarded; and thus the hæmorrhoidal Veins are dilated, the Course of the Blood is retarded and inclined to putrefy, whence follows an Inclination to the Piles, which may occasion a great Number of Disorders in the Brain, if the Blood is not freely discharged.

§. 775. Too great a Loss of Blood either from a *Dilatation* ¹ of the Vessels in the *Liver* ², Intestines, Kidneys, or Uterus; or whether it be from a Rupture, Erosion, or Wound of the Vessels, weakens the Strength, causes a Lowness of *Spirits* ³, disturbs all the Actions, accumulates crude, watery, *pale* ⁴, and *cold* ⁵ Juices, causes a Leucophlegmacy, Dropsy, and

and Relaxation in all the Vessels, augmenting the *Capacity* ⁶ of the arterial System. But Blood long addicted to flow from the hæmorrhoidal or uterine Vessels, or by any other less usual Part, from whence it has been accustomed to evacuate itself periodically, being now *suppressed* ⁷, occasions local and severe Inflammations, and obstructs the Circulation, whence Fevers and an infinite Number of other wonderful Disorders, but more especially surprizing *Hæmorrhages* ⁸ in other Parts.

* This is the usual Way by which Nature endeavours to relieve herself; for she neglects no Part through which there is a Possibility of discharging the Blood through the Vessels entire, without breaking them. The Skin confines the Blood which might otherwise escape through the Vessels in the Surface of the Body; and yet there are many Instances of Blood discharged through the Pores of the Skin in various Parts of the Body, after which Discharge the Vessels have spontaneously closed of themselves. In this City of *Leyden* there is an honest Merchant, who every Month discharges more Blood from the hæmorrhoidal Vessels of the Rectum, than is usually from the Uterus of any Woman; and if ever he endeavours to stop it, he is in Danger of an Apoplexy. But this Discharge by Anastomosis or Dilatation of the Vessels is performed in the following Manner; namely, in lax Habits, the red Blood dilates the ferous Arteries, and through them it passes to the exhaling Vessels, which naturally transmit only an aqueous Vapour; so that the Blood dilating and overcoming the contractile Force of the Sides of these Vessels by the urging

Plethora, makes itself a Passage; but when the Plethora is removed, the Blood ceases to urge the Vessels, and continually lessens its Force, whereupon the Vessels contract and confine the Blood. This may take Place in the Skin, Liver, Uterus, Intestines, Kidneys, &c.

² The exhaling Vessels in every Part of this Viscus, are Branches from the Vena portæ, and are extremely weak, as *Glisson* observes; if therefore these are still farther weakened by Disease, and the Impulse of the Blood increases at the same time, it may then force itself away into the biliary Tubes, and the Plethora may unload itself by the Bowels; and even the Experiments of *Ruyfch* demonstrate, that an hepatic Flux or Dysentery may arise whenever there is too great a Resistance in the Liver, which is a Case neither attended with much Inflammation nor Danger.

³ The Spirits are not separated in the cortical Part of the Brain, like the rest of the Humours in other Parts of the Body; for in the first Case, the Separation seems to be made after the Manner of Filtration by a Sponge, to which is applied a Liquor composed of different Kinds of Particles, from whence the Sponge absorbs only the more subtle. But the Ancients very well observe, that the Variety of Motion is the Cause both of the Blood and Spirit. So soon therefore as the Blood is not conveyed with a sufficient Motion to the cortical Part of the Brain, the Spirits must necessarily be deficient; but those two Instruments, the Blood and Spirits being deficient, all the Actions will flag and grow weak, as happens after Wounds, and at last succeeds a Dropsy, when the Chyle not being formed into thick Blood, does by its Thinness recede into the smaller Vessels, whence it stagnates in the adjacent Cells.

4. 5. There are an infinite Number of intermediate Degrees betwixt the most perfect Life, which is Health, and the most extreme Disease, which is Death. A Loss of Blood therefore will proportionably weaken the vital Powers, if it does not kill; and we may see daily, that those who have been wounded or have had profuse Hæmorrhages, fall into a Dropsy.

6 The Capacity of the Arteries is less, as they are less distended; but the other smaller Vessels in which the thinner Humours are received from the larger Arteries, become more distended from their increased Quantity of Humours.

7 *Hippocrates* prudently observed in his Book of Diet, that when the hæmorrhoidal Flux of Blood or any other usual Hæmorrhage has been accustomed to flow for some time, and that Flux or Hæmorrhage is cured, in that Case all the Passages ought not to be shut up, but one should be left open, by which the Blood may continue to be evacuated. For by these accustomed Hæmorrhages Men are changed almost into the Nature of Women, and suffer the like Disorders from a Suppression of their wonted Discharge, as is usual to Girls who are subject to a Retention of the menstrual Flux; the Truth of which is confirmed by Instances in young Men, who have had such a Bleeding at the Nose suppressed by the use of Vitriol.

8 Hence Women who have a Suppression of the Menfes, are subject to a Spitting of Blood from the Lungs, a vomiting of it from the Stomach, or a Flux from the greater Canthus of the Eye; but upon opening the uterine Vessels, these unusual Hæmorrhages spontaneously cease.

§. 776. The *Semen* ¹ discharged too lavishly, occasions a Weariness, Weakness, Indisposition to Motion, Convulsions, Leanness, Driness, Heats and Pains in the Membranes of the Brain, with a Dulness of the Senses, more especially of the Sight, a *Tabes Dorsalis* ², Foolishness, and Disorders of the like Kind.

¹ We meet with some Cases in the Writings of Physicians where the Semen has been apt to run away from the Patient involuntarily and without his Sense ; but this is certainly a very rare Disorder, nor did I ever see a Case of a true simple Gonorrhæa, where the Semen is discharged without an Erection ; at least not the true Semen separated by the Testicle and preserved in the seminal Vesicles ; though I have often seen a Flux of the Liquor of the Prostate ; and in a virulent Gonorrhæa a Flux of a cancerous and purulent Humour from an Ulcer in the Urethra usually happens. It is indeed true, that the Semen is sometimes discharged in the Sleep ; but then at that time the Mind is always dreaming or entertaining itself with lecherous Ideas : and this last Kind of Gonorrhæa in very studious and splenetic Men is frequent, and sometimes discharges so great a Quantity of Semen, as to bring on an Atrophy or wasting of the whole Habit for want of Nutrition. But in these Cases there is always a pleasing though a false Entertainment of the Mind with Venery. I have sometimes seen the Disease, and find it arises from a Weakness of the whole Body, especially about the Loins, which is followed with a Subsultus of the Tendons, periodical Cramps in the Limbs,
and

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and Leanness wasting the whole Body; and in the mean time a Pain is felt in the Membranes of the Brain itself, which Pain the Patient denominates a Heat perpetually burning within the more noble Parts. But this Disorder is not often to be met with.

² I have likewise met with the *Tabes Dorsalis* in a very comely Youth, who though frequently admonished, nevertheless continued to fight in the Camps of *Venus*, 'till a little before Death he was so deformed, that the round Portions of Flesh which rise up on each Side beyond the Spines of the *Vertebræ*, were consumed and flat like a Table; which is the true *Tabes Dorsalis* so called by *Hippocrates*. In this Case also the Brain itself seems to be consumed, for the Patient becomes stupid or foolish, and afterwards the Limbs and whole Body are invaded with a Stiffness, as I have myself observed the whole Body stiff and contracted from the same Cause; the Eyes themselves which sparkle with venereal Fire, are in this Case dull and insensible from an Atrophy in the optic Nerves. This Disorder most frequently happens to those who are too furious and early in their Combats in the Camps of *Venus*, even from the Beginning of their Youth.—But the Disorder is as rarely to be met with as it is lamentable; for in this Case there are but few Hopes. Milk does not stay with them, and Riding is of no Service, for they complain that it exhausts their Strength; for after muscular Motion and Exercise, they lose more of their Strength and Semen in their Night-dreams; so that they arise from their Bed the next Morning covered with a Sweat, and rather weakened than refreshed by their Sleep. But neither are Spices serviceable in this Case, as they produce the same Effects with Exercise; and we can only hope
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to relieve them by good Aliment, gentle and moderate Exercifes, with washing of the Feet and Frictions of the Skin cautiously used. The *Greeks* were very well acquainted with the Difficulty of curing this Diforder, which feems to have been more frequent in former Ages, from their daily uſing of the warm Bath, which not only ſtimulates to Venery, but alſo relaxes and weakens the Body. In ſhort, this is a Diforder which I have frequently ſeen, but have never yet been able to cure.

§. 777. Too *copious* ¹ a Diſcharge by Urine occasions Drineſs, Imperviouſneſs, and Heat of the Humours, unextinguishable Thirſt, Crudities, Lowneſs of Spirits, Leanneſs, Atrophy, and Diforders of the like Kind. Too great a Diſcharge by *Sweat* ² produces likewiſe the ſame Effects. But a *Suppreſſion* ³ of the Urine diſtends the Bladder, Ureters, Pelves, and Kidneys, and by *putrefying* ⁴ corrodes, weakens and deſtroys them, communicating an *alkaline* ⁵ Acrimony to the whole Maſs of Blood and Lymph; whence by injuring the tender Fibres of the Brain, it occasions Anxieties, Reſtleſſneſs, Drowſineſs, Vertigo, *Apoplexies* ⁶ and Death.

¹ This is either a true Diabetes, in which the diſcharged Urine is white, turbid, ſweet, inodorous, and partaking of the Chyle. The Cauſe is ſuch a Relaxation in the Veſſels of the Kidney, as eaſily permits the Chyle to paſs through like the lactiferous Ducts in the Breſts. Or elſe the Urine is diſcharged aqueous and limpid like Spring-water, with little or no Smell and Taſte; as frequently happens

happens in hysterical, hypochondriacal and weak People, in whom it is sometimes called *Hydrops ad Matulam*. The first Kind of this Disorder soon destroys the Patient by depriving the Body of all its Nourishment: And the latter Kind does great Injury to the Body, and more especially it brings on an Insensibility or Dulness. Of this, I saw a remarkable Instance in a Lady, who was subject to a profuse Discharge of Urine without any manifest Cause, of which she expired with a cadaverous Suppuration diffused throughout the whole Panniculus adiposus all over the Body; namely, because the more aqueous and fluid Parts of the Blood were drained off, and the rest rendered impervious through all the small Vessels.

² Too much Sweat in a healthy Person produces the same Disorders with too profuse a Discharge of the Urine, namely, it inspissates the Blood and renders all the Humours impervious, so as to occasion all Sorts of inflammatory Disorders and Gangrenes. Every Person who has weak Lungs is subject to frequent Sweats. The Husbandman though daily exercised with Labour, does not sweat much at his Work, whereas weak People are in a Sweat with the least Exercise, and even sometimes run down in a Sweat in the Night, only by the Heat of the Bed. This Sweat arises from such an impoverished or thin State of the Blood, that its Particles do not sufficiently cohere into Globules, large enough to be retained in the sanguiferous and ferous Vessels; whence the more fluid Parts separate and depart from the rest spontaneously. And therefore here no Cure can be expected, but by restoring the Density and Compactness of the Blood; otherwise if the Disorder is neglected, it produces a Consumption, Cachexy, and Death.

³ This is otherwise a true Ischuria, the Cause of which resides in the Bladder, and must then be placed either in the Neck of the Bladder, or in the Urethra. But there is another spurious Kind of Ischuria, when the Cause resides in the Parts above the Bladder; and this last must reside either in the Pelvis of the Kidney, or in the Ureter, in which Case both of them are very much distended; or lastly, it may be lodged in the renal Vessels, or the circumjacent Parts compressing those Vessels.

⁴ The Urine has no Acrimony while it stagnates in the Kidney, as is evident from the Kidneys of various Animals not tasting of the Urine; but in the Pelvis, the Urine becomes more acrid, still more acrimonious in the Bladder, and the sharpest of all at length when exposed to the Air, which soon inclines it to a State of Putrefaction.

⁵ The Urine is the general Lixivium of the Blood, freeing the whole Mass from its rancid alcalescent Oils and Salts. When the Urine is retained, all those excrementitious, oily, saline, and earthy Parts, are left in the Blood. Such a Suppression of Urine may be sustained for near twelve Days, but if the Disorder is protracted to a greater Length, it becomes fatal; for within that Time there is so great a Quantity of acrimonious Particles generated in the Blood, that it begins to corrode the tender Vessels of the Brain, and escapes into the Ventricles.

⁶ The most subtil Liquors have a particular Tendency towards the Head, as is well known of Wine; and thus the Urine being retained, and consisting of acting Particles, affects the Head, and causes the Person to dream of being drowned in Water, induces Sleepiness, a Vertigo, Apoplexy, and at last Death itself.

§. 778. Too great ¹ a Discharge by the Sanctorian Perspiration, causes extreme Weakness, Fainting, and sudden Death. But if the Perspiration is *diminished* ² or suppressed, it causes the smallest Vessels of the Skin to dry up and wither, and by that means the larger excretory Ducts of the Skin are obstructed and blocked up; hence the Circulation is changed, the acrid Particles which ought to have exhaled are retained; whence a *Putrefaction* ³, Crudity, Fever, Inflammation, Abscess, &c.

¹ Which may be discovered by the Balance or Steelyard. But a Person never perspires so copiously as when he exercises violently in a cold Air; so that the Heat generated in the Body by Exercise, overcomes the external Cold; as for instance, in those who skate upon the Ice; for one who should enter fasting upon this Exercise, would quickly faint away, so that if there was none of the Chyle left to be consumed, he might fall into a gaping Hunger, which in a little Time might so far exhaust the Strength, as to bring on Death itself, as not unfrequently happens in the more northern Countries.

² *Sanctorius* has explained the Causes of the Disorders resulting from the Retention of the perspirable Matter. These Disorders may be referred to two Classes. The first Usefulness of Perspiration is to keep the Skin moist; in order to which, Nature has supplied it with small Vessels to be filled with Juices. But if we suppose those Vessels which are little larger than the perspirative ones to be obstructed, you will perceive that the
smaller

smaller Vessels must dry up as in an ardent Fever, when the most liquid Part of the Humours is dissipated, and the very small Vessels of the Skin being deprived of the usual Afflux of thin Juices, in a little Time dry up, and render the whole Skin rough.

³ The second Use of the Skin is to free the Blood from those superfluous, subtil, and acrimonious Particles of the Humours, which, being retained, might mix themselves with the Spirits, and disturb the Functions of the Brain. If now we suppose the Perspiration to be suppressed, the Matter which ought to have perspired, must stagnate or mix again with the Blood, from whence must follow many bad Consequences, and a more speedy Putrefaction, as the perspirable Matter is more subtil.

§. 779. *Cold Things* ¹ applied externally, shut up the Pores, *contract* ² the Fibres, repel back the restrained Humours, and hinder the Exhalation of them, so as to produce the same Effects with an obstructed Perspiration. But hot Things open the Pores, *relax* ³ the cutaneous Vessels, dissipate the Humours, and draw them towards the Skin; but then they exhaust or dry up the Body. *Moist* ⁴ Things wash away the excrementitious Parts from the Skin, open the Pores, relax the Vessels, and sollicit the Humours *outward* ⁵; so that in Excess they may produce Diseases, like those from too much Sweat (§. 777.): But *dry* ⁶ Things produce the contrary Effects. From hence we may understand the Use and Efficacy of Baths, Fomentations, and topical Remedies,

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being first acquainted with the Nature of the Materials, their *Qualities*⁷, Manner of Action, and Length of their Application : And we may likewise easily understand the Effects of those Things mentioned before §. 744. N^o 4.

¹ These cold Things are of three Kinds ; 1. Air, which is always colder than our Blood, even in the hottest Weather ; but when the Air is extremely cold, it is, in a Manner, like a cold Bath to the Body. The cold Air is tolerable enough to us down to the 33d Degree of *Farenheit's* Thermometer, at the 31st Degree of which, Water freezes. But the Air is sometimes much colder than this, since the celebrated *Reaumur* at *Dantzick*, observed the Thermometer to descend 32 Degrees below the first ; and therefore Air which causes the Thermometer to descend 20 Degrees below the first, cools the Body more than the coldest Water. 2. Water which can never be rendered colder than 33 Degrees above the first ; for at the next Degree it turns into Ice. 3. Water saturated with Salt may communicate a much greater Degree of Cold, and yet retain its Fluidity ; and therefore by this means a Bath may be rendered much colder, than if it consisted of pure Water.

² Suppose a Man, who is hot, exposes his Breast to a cold Air ; by this means the Skin contracts into less Compass, and at the same Time raises its Surface into little rough Tubercles like the Skin of a Goose ; which Tubercles are the Extremities of the exhaling Arteries coming through the Skin, and raised into Tubercles, because the Humour being urged on behind, cannot be discharged thro' the contracted Orifice of the exhaling Vessel ; but upon the Application of Heat, all these rough Tubercles vanish. All Bodies contract into a smaller

smaller Compass by Cold, as the Royal Academy at *Paris* has demonstrated by Experiments on Iron. Therefore when the Skin is contracted by extreme Cold, all the cutaneous Vessels are shut up, and repel their contained Fluids inward through the Veins to the Heart and larger Vessels; and therefore the Parts within remaining hot, there arises a Disproportion betwixt the external and internal Vessels; whence we may understand, that the Use of the cold Bath ought to be prescribed with great Caution. Certain it is, that the cold Bath can produce such considerable Changes in the Body, that there is no Room to wonder that these Baths should have acquired such great Reputation at *Rome*, in the Time of *Augustus*, from the Recommendation of *Antonius Musa*; and at present they are in high Repute throughout *England*. But it ought to be considered, that by these Baths the Humours are urged with a greater Impetus towards the Head; for the whole Body is compressed by the Water and contracted by the Cold, only the Head cannot be contracted from Cold by its bony Nature and spheroidical Figure; and therefore the Vessels will continue lax and free in the Head as before; in Consequence of which, the Humours will flow from the compressed and obstructed Parts towards the Head. To this some would object, that the Patient ought to be admonished to dip his Head into the Water likewise; but they do not consider that even that Means will not contract the Vessels of the Head, for the Reasons before mentioned.

³ More especially they draw all the Humours from the internal Parts outward. Hence a hot Animal continually lessens in Weight, and in a great Heat we are in a Manner dissolved into a Water. But by intense Heat the Vessels are also very much dilated, whence the grosser Humours
escape

escape into the smaller dilated Vessels, whence innumerable Diseases from an Error of Place in the Humours, &c. The celebrated *Bernier*, in his Embassy to the Emperor of *Indostan* in *Cachemira*, though the Land appeared a Paradise, yet in ascending the Mount *Bembor*, found the Heat so excessive, and his Thirst so great, that he was obliged to be continually drinking, and sweated to such a Degree, that in the Space of Half an Hour, not a Drop of the Liquors drank remained in his Body; and every Kind of Animal perished except the Camels, which alone bear intolerable Heats without Injury.

⁴ Moist Things relax and weaken the whole Body, as we experience in a moist Air, in which we are altogether dull.

⁵ Throughout the whole Surface of the Body, open the Mouths of exhaling and absorbing small Vessels; if now a Moisture is applied to the Surface of the Skin, the Arteries will be dilated and relaxed, and the Humours will be exhaled more copiously, because the Ends of the dilated Vessels give a less Resistance; in the mean Time the absorbing Veins being relaxed and dilated like the former, give Entrance to the Liquor which is applied to the Skin, whence the Body becomes sensibly increased in Weight, as appears by the Steelyard, according to the Experiments of *Bellini*, in his Chapter, *De Balneis*. A moist Air therefore, with respect to the Arteries, drives the Humours outward, but with respect to the Veins, conveys a Moisture inward, and by that means dilutes the Blood.

⁶ A dry Air and dry Cloth are bibulous Bodies, and attract Water; as is evident from many Experiments which I made for this End, and by which it appeared to me, that such Cloths are capable of

absorbing many Pounds of Water in a short Time. The same is also demonstrated by the Experiments of Cloth-workers; who know that wet Cloth suspended in a quiet, but dry Air, becomes dry in a few Hours; but if the Air itself is moist, the Cloth retains a Damp for a long Time. If now we consider the Skin of the human Body as a Piece of Cloth, always moist in a healthy State, as appears from the Vapours which ascend from it, and obscure a Piece of polished Gold, it will be from thence evident, that a dry Air speedily and copiously absorbs this Moisture of the Skin; but this Moisture is no sooner absorbed, but it is followed by another, so that within the Space of an Hour, a Person may be exhausted and killed in a Stove.

7 There is a great deal of Difference in the Efficacy of a Bath, according to the Nature of the Materials of which it is composed; as whether it is of Oil, Urine, Water fresh or salt, &c. but in general, a Bath alters the Body more in Proportion, as the Liquor applied consists of more moveable Particles. The stagnant Water of a Bath is not very efficacious; but if the same Body be suspended in the Vapours of hot Water, it will be an Hundred Times more powerfully altered by those Vapours than by the stagnant Water; from hence arises the wonderful Efficacy by sweating with the Vapours of burning Alcohol in a close Place, or under a Blanket; which, to my own Knowledge, has removed venereal Tumors themselves.

§. 780. But there are, besides these, some internal morbid Dispositions of the Body, of so general a Nature, that a great Number of Diseases may derive their Causes from thence; for

for which Reason, they are usually laid down and considered, or explained by their Causes in a general Enumeration of the Springs of Diseases; and these are chiefly a Plethora, Cacochymia, or heterogeneous Bodies within the Animal, such as Worms, Stones, and the like.

§. 781. A Plethora is produced, continued, and increased in People who have strong chylicative Viscera, lax Blood-vessels, feed plentifully upon Aliments affording good Nourishment, being of a *middle Age*¹, a sanguine Habit in the *Winter*² or Summer-time, and in a moist Air, and who have their Minds easy or unemployed, or have suffered a loss in their *Limbs*³, or a Suppression of any wonted Evacuation. But the Effects of a Plethora are, that it renders the Patient incapable of bearing either Heat or Exercise, causes an Extension of the larger Vessels, and a Compression of the *smaller*⁴; so that upon the least Occasion the Vessels are *lacerated*⁵ or burst, and the Humours obstructed in their Course, with Weakness and Laziness of the whole Body, &c.

¹ Namely, betwixt the Age of 18 and 48, during which Interval of Time, a Person is most liable to a Plethora.

² The Efficacy or Power of Winter is to fill the Vessels, and at the same to increase the Strength and Action of the chylicative Viscera; but in Summer-time the Vessels are expanded, and the

Humours rarified, whereas in Spring and Autumn, a Plethora is but little increased.

³ A Plethora generally happens to such as have lost any Limb. When very strong Men have lost both Legs and Thighs in Battle, and are afterwards cured, the Stomach and chylicative Viscera in the mean time continue their usual Strength; the Lungs are equally large, and the Patient continues to make as much Blood as before; but then one fourth Part of the Blood-vessels being by this Accident removed from the Body, the other remaining Vessels will be a fourth Part more filled by the redundant Blood, if we suppose the amputated Legs and Thighs to make up one Quarter of the Body; and we know by Experience, that a fatal Plethora often arises in such People. They ought therefore to be admonished to keep to a more spare Diet, to drink less, and to use frequent Bleeding, till the Body shall by degrees adapt itself to such a sudden and unnatural Disproportion in its Parts.

⁴ A plethoric Person when at rest, is perhaps under no Uneasiness, but if the Blood is a little increased by Exercise or any other Means, then the Plethora excites Disease: as if the Humours are rarified by too much Heat, since Heat expands the Fluids more than the Solids, the Vessels not yet expanded, will be violently extended by the Humours. Thus plethoric People will be incapable of bearing those Changes which inevitably attend on Life, such as Exercise of Body, Heat of Weather, &c.

⁵ When the Humours are urged with a preternatural Force into the Vessels, these last are ruptured, and the Blood escapes from the Nose or some other Part; but if these natural Outlets afford too great a Resistance to the Blood, then

then internal and fatal Hæmorrhages may arise in the Viscera.

§. 782. A *Cacochymy*, or depraved Quality of the Humours, may be considered as resulting from the Causes without, and not in the Humours themselves; or in those inherent within the Humours; and both these may be again considered as affecting all together, or only some particular Humour.

§. 783. If then, in the first Place, the Humours are *moved* ¹ too swiftly through the Vessels, this will cause a Compressure, Attrition, Attenuation, Heat, and *inflammatory Disposition* ² of the Juices, with the ill Consequences thereof already explained from too much Exercise (§. 766.). But a too slow Motion of the Humours produces Disorders like those before described from too much Rest or Inactivity of the Body (§. 769.). But an Excess or Deficiency in the Motion of the Spirits of the *Nerves* ³ is more especially dangerous, since from thence all the digestive Powers, Secretions, and *Excretions* ⁴, are disturbed or injured, so as to produce different Disorders almost of every Kind.

¹ When all the Humours are well conditioned, then the most simple and frequent Disease consists in too great a Motion of the Blood, the Effects of which are to press the Particles of the Humours closer together, to expel or discharge the most subtil of them from the Body, and then to pro-

duce all the Disorders which happen from a Plethora.

² We know this Disposition to be present, when the Globules of the Blood begin to be so violently compressed, that they touch each other not in single Points, but in plain Surfaces like Cakes; for the constituent Globules of the Blood are capable of changing their Figure, which is spherical from a moderate Motion, but by an excessive Motion, the Particles of the Blood are compacted into impervious Masses.

³ Passions of the Mind are altogether febrile Disorders of the Spirits; for as the Essence of a true Fever consists in a swifter Circulation of the Blood through the Heart and Arteries, so in Passions of the Mind, that is moved and acts more strongly, whose Presence is required immediately for Motion, whence the Force of the Heart increases, &c.

⁴ No one will deny, but that all the Actions in the human Body may be reduced to the Compressure of the Solids upon the Fluids, and the Impulse of Fluids upon the Solids. Hence it is evident, that an increased Motion of the Humours augments their Impulse against the Apertures of the smallest Vessels which terminate in a round Figure, and are generally invested with a Sort of Sphincter, like those larger Sphincters of the Mouth, Œsophagus, Pylorus, Anus, Bladder, Ductus Pancreaticus, and Choledochus, &c. but all these Sphincters are governed by the Spirits, which being disturbed in their Motion, must necessarily pervert the several Actions of the Body.

§. 784. But too great a *Fluidity* of the Humours occasions too profuse a Discharge or
Dissipation

Diffipation and Waste of them, perverts the Secretions, occasions a Shrinking, Emptiness, and Weakness, in the larger Vessels, Obstructions, Ruptures and Suppurations in the smaller Vessels; and such a too great Tenuity of the Humours, is more especially pernicious, when accompanied with great *Acrimony*² or violent Motion.

* When the Humours in general are too thin, even in the most healthy Person, they are, by the Force of the Heart and Arteries, pressed into the smaller Vessels, in which there is a less Resistance; and therefore the Humours will there stagnate or be discharged. It was necessary for me to make this Observation, since some celebrated Physicians (*Cra-nen* and *Bontekoe*) have taught that the Blood is best, and the most free from Vice or Disease, when all the Humours of the Body are the most fluid. This Opinion has spread so much, that very eminent Persons have patronized, and very publickly defended it; and they have endeavoured to insinuate, that nothing is so much conducive to Health, as plentiful drinking of Tea and Coffee, which dilute and thin the Blood. But for my own Part, I am surpris'd, that Men should pretend to be wiser than the Laws of Nature, which speak for themselves. For this Disposition of the Humours which they reckon a Perfection, subjects them to a greater Consumption: For this is a too small Cohesion of the Humours in active Bodies, which will indeed enable the Person to be active in Body, and of ready Intellects; but the Humours will escape by the Emunctories, unless they are restrained; whence the Person must perish of a Consumption, from which he can never be cured, but by restoring the Blood to its due

Thickness. But in such a Condition of the Humours, the Cure is to be brought about by a proper Regimen of Diet, with riding on Horseback in the free Country Air, with Frictions of the Body; for by these Remedies, the Blood is compacted and rendered of a more firm Texture, without which the Physician labours to no Purpose. From hence it is evident, how bad a Practice it is to give Mercury in these Diseases; for by this Means, the more fluid Parts of the Blood are drove from the sanguiferous into the serous Arteries, while the grosser Parts are left behind, and become so much of a pitchy Nature, as to be hardly miscible with the thinner returning Humours; so that from this previous Excess of Fluidity in the Humours, follow Obstructions and Diseases of the worst Kind. When a Person is in the Flower of his Age, and the Vessels are full, this great Fluidity of the Humours may be tolerable; but then this will have its Benefit but of a short Duration, like a Flower which opens in the Morning, and withers in the Evening. The greatest Fluidity of the Humours gives the Person a very active Life, but of short Duration; whereas a due Thickness and firm Texture of them, renders Life constant and healthy, and of long Duration.

² Such is the Disposition of the Humours in the Scurvy, contracted at Sea from an alcalescent Cause.

§. 785. But too great a Tenacity of the Humours causes Obstructions, Distensions of the smaller Vessels, Pains and Tumors, especially in the Glands and arterial Plexuses. But when this too great Tenacity is joined likewise

wise with *Acrimony*¹, then according to the different Proportion of each, there is a great Destruction of the Vessels, whence the Humours are extravasated, and form Pustules, Inflammations, a Gangrene, Sphacelus, Cancer, malignant eating Ulcers, Caries, and the like; but sometimes Acrimony is present with, and sometimes it follows after, a too great Tenacity of the Humours.

¹ Surgeons well know, that Caustics applied only by themselves to the Skin, produce little or no Effect; but when they are retained by applying a sticking Plaster over them, they then operate violently; for the greatest Corrosion follows when Acrimony is joined with Tenacity. But by Tenacity, I here understand any Thing, which, with Difficulty, admits of being washed off, or separated from, the Part to which it adheres. The most healthy Man infected by a Prostitute, receives from her a Matter which is not thick or tenacious, but endowed with a particular Acrimony, capable of converting all the Humours into a Kind of Ichor, productive of those Symptoms which we call the venereal Disease: But this Acrimony being lodged in the Oil or Fat of the Body, and in the Medulla of the Bones, becomes then so tenacious, that it can hardly be extricated by all the Endeavours of Art. In the same Manner, very bad Diseases arise from violent Passions, when the more fluid Parts being dissipated, the more gross Remains of the Humours stagnate in the Extremities of the Vessels, where becoming acrimonious, they must of Necessity destroy the Vessels and solid Fibres, within their Contact, especially those tender ones of the Brain. In a healthy Person, the Blood is
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of so mild a Nature, that it creates no Pain, being dropped in the Eye; nor does Pain arise in any Part of the Body from such Blood; for the Blood of young Puppies is a good Collirium, and rather mitigates Pains of the Eyes. But when the Blood is too much agitated by local Motion, it then becomes so acrimonious, that even the Sweat smells fetid, which if retained, would putrefy the Blood itself: And the Blood which in itself is so mild and sweet, does by an increased Heat become so putrid as to excoriate the Hand upon touching it; for such has been the Consequence of handling dead Bodies very putrid.

§. 786. Crude acid Humours, *rough*¹ Acids, or vinous fermented Acids, Acids from the Chyle or from *Milk*², fixed or volatile Alkalies, or *alkalescent*³ Substances, and such as abound with a muriatic or ammoniacal Salt; as also those which are replenished with an aromatic, oily, saline Acrimony, with *insipid*⁴ Oils, &c. produce Disorders very like those before mentioned (§. 760, to 767.).

¹ *Hippocrates* justly observes, that in the human Body there are not only the Qualities of Heat, Moisture, and Cold, to be found, but also bitter, acerb, salt, and oily; which Doctrine still holds true.

² Besides those before enumerated, I know of no other acid Salts generated in the human Body.

³ I could never yet find any Alkali in the healthy Humours, but only an ammoniacal Salt; and I persuade myself, that I have pretty well overthrown the Opinion of Alkalies abounding in the Humours. I endeavoured, by all Kinds of Experiments,

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riments, to discover whether there was any Alkali contained in several Ounces of red, foetid, and acrimonious Urine, which I extracted from a certain celebrated Professor of this University, who died on the sixth Day of an Ischuria; but yet I could not discover any Signs of an Alkali, even in this Urine. Nor do ever any of the Juices of the human Body become alkaline, without first greatly injuring the tender Fabric of the Brain; so far are the Humours from being alkaline, as they are said to be by *Helmont*, *Sylvius*, *Tachenius*, and others.

⁴ When these Oils abound, they occasion Diseases.

§. 787. But *insipid*¹ *Phlegm*², *acid*³, *saline*⁴, *glassy*⁵, or viscid *Pituita*⁶, so much talked of by the Ancients, may be understood, both with respect to its Origin and Effects from what has been at §. 785 to 786.

¹ Pituita or Phlegm is a thick Humour drawing out into Threads like Bird-lime, difficultly diluting with Water, and composed of mucous Particles joined together, with a considerable Degree of Tenacity. This with the Ancients, and with the common People, is often esteemed to be the most frequent Cause of Diseases; for these last seldom complain of any thing else to the Physician, but of Acid, Bile or Phlegm; which is certainly a very wrong Notion, which I was early admonished to desert by a certain prudent and elderly Physician.

² This is natural, and no ways offensive to the Body. Even every Part of the Body is supplied with such an insipid Mucus or Pituita; and
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the Eyes themselves are not moistened with a mere Water, but with a Humour which easily concretes and thickens into Pituita. Nor is the Mouth supplied only with Saliva, but it is also furnished with a great Quantity of Mucus, which continually drivels from the Mouths of the most healthy Animals. This Kind of Pituita or Mucus, is also found in the Wind-pipe, Lungs, Stomach, Intestines, Bladder, Urethra, Vagina, Articulations of the Bones, &c. There are three Regions in the Body supplied with Pituita; namely, the whole Surface of the Skin which comes immediately in Contact with the Air, as in the Face, which is all over covered with a Liniment, and which being wiped with a very clean Cloth, tinges it with a yellow Oil. 2. Wherever there is any great Attrition, as in the Groins, Nates, and Joints, which sustain great Weights. 3. Wherever there is any Acrimony, as throughout the whole Mouth, Fauces, Nose, Oesophagus, Stomach, Intestines, and urinary Bladder. These are the natural Seats of the Pituita. Those are therefore much mistaken who think to conquer Diseases by purging away the Pituita. It is indeed certain, that a Purge will evacuate Humours in the Form of Mucus or Phlegm, from the Body of the most healthy Person; but at the same Time, that Mucus is healthy, and necessary to Life. The true Uses of the Pituita, and the Diseases apt to arise from its Depravity, are enumerated by Dr. *Havers*, who, among others, from hence derives the Gout and Rickets. But even *Hippocrates*, before *Havers*, has left us an Observation, that when the mucilaginous Humour stagnates about the Joints without being dispersed by Motion, it inspissates by Degrees, and causes a Defluxion upon the Parts. But even the most healthy Humours may become the most diseased

and

and pernicious, when they are not duly attenuated, so as to be capable of transpiring.

³ Acid Humours and Phlegm are apt to be generated in the Stomach, and *Primæ Viæ* of weak Persons, and in Girls, from an Inactivity of all the Vessels which ought to attenuate the Pituita; so that by a languishing of the vital Powers, Disease ensues. Vegetable Food is apt to turn into an Acid, and Milk generates a Curd which hardens together, and cannot be attenuated by the Stomach of young Children and weak Girls; and therefore this Kind of Pituita is peculiar to the younger Age.

⁴ The Humours which distill in the Scurvy, in Catarrhs, or in a Coryza are saline. They who live for the space of a Fortnight upon nothing but Whey, without taking any other Food, as I once did myself, will nevertheless have the same Salt in the Urine, as if they lived upon acrimonious Food. Hence it follows, that Nature makes a certain Quantity of Salt from the ingested Aliments, which before contained only the Materials to be formed into Salt. And this Salt made from the Food by Nature, being mixed with inactive Phlegm or Mucus about the Articulations, thickens and forms a Matter offending both by its Tenacity and saline Acrimony.

⁵ This has been described by the Ancients, and after being a long Time ignorant of the Disorder, I at length met with it in two extraordinary Cases. A Citizen of *Leyden* appeared languid, pale, bloodless, and cold; so that she seemed hardly to live, though at the same time she was very full of Juices; and in this Woman I saw, as *Galen* describes it, a copious Discharge of a pellucid vitreous Phlegm, extremely thick, and like Jelly of Hartshorn which has been hardened in the Cold
and

and quite destitute of any Smell. The Ancients have pronounced this vitreous Phlegm to be a fatal Disorder, not curable by Art, as the vital Powers have entirely deserted the Body together with the natural Heat; nor did either of the two Patients recover, which I saw in this Disorder.

§. 788. *Yellow*¹, vitelline, porraceous, eruginous and brown Bile, is often made of these Colours by unusual *Commotions*² or Agitations of the Body, Convulsions and Passions of the Mind, though the Cause thereof is not yet to be accounted for; in this Case, the Bile produces many and malignant Disorders, Sickness and Aversion to Food, *Anxieties*³, *Hiccups*⁴, *Heart-burns*⁵, Vomiting, iliac Passion, Cholicks, Gripes, Flatus, rumbling Noise in the Bowels, *Diarrhæas*, *Dysenteries*⁶, *acute Fevers*⁷, Convulsions, &c.

¹ The natural Colour of the cystic Bile is yellow; but vitelline Bile like the Yolks of Eggs, is of a paler Yellow like the hepatic Bile. The porraceous Bile is much greener like Leeks; and the Isatodes or dark brown-coloured Bile, is, as it were, compounded of a black, green, and yellow Colour together.

² A healthy Person who ventures upon a rough Sea, is soon troubled with a Vomiting, first of the Aliments, and then of Bile, which appears in the beginning yellow, but is afterwards by Degrees vomited of a more intense green Colour, which is the deeper in proportion as the Disorder is more violent. Thus also a healthy Person who has received a Blow upon the Head, vomits eruginous Bile, if the Encephalon or Brain itself is injured;
agreeable

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agreeable to the most ancient Observation of *Hippocrates*.

³ Greater than in any other Kinds of Vomiting; for so soon as the Bile enters the Stomach, it occasions extreme Uneasiness, until it is discharged by Vomiting.

⁴ Hiccup follows from the continued Sickness and Pain of the Stomach, which cannot hold long without causing Hiccups.

⁵ Heart-burns here arise not from a Sourness, nor from eating too much Spices, which make the first and second Species of this Disorder; but in this Case it arises from the Bile, which being absorbed and returned into the Blood, excites a Fever likewise.

⁶ Dysenteries, and various other Disorders, follow according to the different Parts of the Intestines, upon which the Bile exerts its Force. In Infants, Diarrhæas with green Stools arise thus from the Bile, which no one can cure without knowing how to temperate the Acrimony of the Bile.

⁷ Which acute Fevers are reckoned extremely dangerous, when the Bile once mixes itself with the Blood.

§. 789. But *Atrabilis*¹, so called from its Colour and Seat wherein it is collected, and from whence it is discharged, is sometimes as sharp as very sour *Vinegar*²; but sometimes it is like *putrid*³ Blood, corrodes, burns and dissolves the contiguous solid Parts, *excites*⁴ Inflammations, Gangrenes, Sphacelus, excruciating Pains, and violent Effervescencies of the Humours. But the *Atrabilis*, as a Cause
of

of Diseases, is ascribed to be of three Kinds ; 1. the *mildest* ⁵ of which is formed from the Matter of the Blood itself, agitated with too violent Motion, whence it is said to be Aduſt (§. 766, 782.) ; 2. the ſecond Kind of Atrabilis is formed of the firſt, more and more *digested* ⁶ and heightened by the Continuance of the ſame Cauſe ; 3. and the third Kind is from *corrupted* ⁷ Bile, which is more acrid and malignant, in Proportion as it is either of a yellow, vitelline, porraceous, eruginous, or black-green Colour, the laſt being worſt of all ; and hence the *Effects* ⁸ of it are various, according to its different Nature and Colour, with the Nature of the Part upon which it ſettles and exerts its Force.

¹ A black Humour diſcharged by Vomiting, was by the Ancients termed Atrabilis, as coming from thoſe Parts which are inhabited with the Bile.

² Which being mixed with Earths, ferments like Oil of Vitriol, and ſets the Teeth on Edge. Such has been deſcribed by *Hippocrates*, and ſuch have I ſeen.

³ For when putrified it is the worſt of all Kinds, and occasions incurable Diſorders.

⁴ For then the acrimonious Bile is heated and preſſed from the Inteſtines.

⁵ The mildeſt Kind is called an atrabiliary Humour, rather than Atrabilis, being in Reality aduſt Blood, which contains oily, earthy, and acrid Particles, after the moſt ſubtil Parts have been exhaled and diſcharged from it.

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⁶ The most tenacious and Pitch-like Part of the Blood; and this Degeneration of the Humours is more malignant than any. The Ancients have denominated it Atrabilis; and it is more especially generated in the hottest Part of the Summer by too great Motion.

⁷ This is of all the worst, the Blood being more vitiated and corrupted as the Bile is more acrimonious. It arises from Bile putrified, either in the hepatic and cystic Ducts, or in the Duodenum. This Kind of Atrabilis is sometimes vomited up in Fevers, which Vomiting no one can cure unless he is acquainted with the Cause, but here Diluents and such Things as temperate the Bile, generally preserve the Patient from Death.

⁸ It more especially corrodes all the Vessels thro' which it flows, and excites violent Fevers.

§. 790. The *Blood*¹ also with the Serum and Bile, when charged with a predominant Acid, Alkali, muriatic, saline or *oily*² Acrimony, or with Earth, produce the Disorders which we mentioned before to arise from like Principles (§ 760 to 767 and 786.)

¹ Namely, the aggregate Mass of all the Humours; but the Serum contains and furnishes all the Humours, except the red Blood. When a saline Acrimony predominates either in the Blood, Serum or Bile, those Humours being put in Motion, corrode and destroy the smallest Vessels, and produce a numerous Train of Disorders.

² The Oil or Fat putrefied in the Cells, and suddenly returned into the Blood and conveyed to the Heart, produces wonderful Disorders.

§. 791. The Serum of the Blood, Bile and *Urine*¹, form *Stones*² of their groffer Parts, which Stones appear to be composed of a volatile *Salt*³, Spirit, *Oil*⁴ and Earth united together in a particular Manner. But these increasing in *Bulk*⁵, do by their Weight or *Motion*⁶ compress the adjacent Parts, obstruct, wound or injure the Vessels wherein they are contained; thus they intercept the Course of the Humours, create Pain, Inflammation, an Ulcer, Gangrene, Callus, and the Consequences resulting from these.

¹ I have examined the Urine of an hundred People, and have hardly found one among them which has not contained calculous Matter; and I have already demonstrated in my public Lectures upon the Calculus, that all, and even the most healthy People, carry the Seeds of Calculi within them. This Kind of Body is therefore no monstrous Production in Nature, since it is composed of the elementary Particles themselves of the Body, which have been rendered incapable of continuing their Office in the Body, from whence they ought to be discharged in the Urine, as appears by the Microscope. One of these fleecy Particles is not a Calculus, but an hundred of them joined together, may form a Calculus equal to a Grain of Sand, and of a thousand such Grains may be formed a large Stone. Chemistry demonstrates, that the Principles of a Calculus are the same as in a Bone, namely Earth, Salt, Oil, and Spirit. But Calculi are often found in the salival Ducts, in the Air Vessels of the Lungs, and in the biliary Ducts, as well as in the urinary Passages. Among an hundred

§. 791. *The Causes of Diseases.* 483

dred People extinguished by chronical Diseases, there will be hardly one found without calculous Concretions in some one Part of the Body. But they are seldom formed in the Blood. They arise more especially in People who use no Exercise, and are hardly ever found in those who lead an active Life, but in those chiefly who are confined to their Bed for a long Time, as lying flat upon the Back conduces much to the Disorder.

² These Calculi are hard friable Bodies, dissolvable almost in no Liquor besides Spirit of Nitre; their Residence being in the Cavities of our Vessels. They do not proceed from any Degeneration of the Humours, but seem to be formed from those elementary Particles which have been wore off from the Body.

³ This is seldom either sea Salt, acid, or fixed alkaline Salt; for Dr. *Storck* has demonstrated in the Philosophical Transactions, N^o 157. that from two Ounces of calcined Calculus, there is hardly a Drachm of Earth, all the rest of the Mass being volatile, and forming a great Quantity of Oil and Salt; the same Thing is also confirmed by Experiments in the Vegetable Staticks of Dr. *Hales*, who found that the Stone of the Bladder generated a greater Quantity of elastic Air than any other known Body.

⁴ But this Oil is putrid.

⁵ The first bad Consequences of a Calculus, is, that it increases in Bulk. It is an easy Matter to make a Calculus, by placing a Bit of Gravel, or any Kind of Stone, in a Chamber-pot, pouring recent Urine often to it, keeping the same warm; and there will be continually some Part of the calculous Matter in the Urine depositing itself about this Magnet, which will enlarge itself or grow to a considerable Bulk, by concentric Lamellæ or

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Coats like those of an Onion. Add to this, the rough Surface of the Stone, which greatly injures the sensible Parts of the Body.

⁶ A Calculus of itself being at rest, gives no other Uneasiness than that of a Weight, but at length irritating by its Bulk, Weight, and Roughness, the sensible membranous and muscular Parts irritated, do then endeavour to expel the offending Body, and by rubbing themselves against the Calculus, the Pain becomes more intense as they more powerfully endeavour to expel the Calculus. Thus in those who have had a small Particle of Sand fallen into their Eye, the Eye-lid immediately contracts itself, and shuts with a convulsive Motion, so powerfully, that the strongest Person cannot open it, by which Contraction the Tears are expressed to wash out the Sand; so that, as *Helmont* rightly observes, in his Treatise *De Lithiasi*, a Membrane inflames itself. In order therefore to remove the Pain which arises from a Stone, one must necessarily take off the Attrition betwixt that and the Membranes, that is, we must hinder the Bladder from contracting itself round the Stone.

§. 792. The Eggs of *Insects*¹ being taken into the Body with the *Air*², Food, and *Drink*³, and mixed with the Mucus of the Intestines or Fæces, or lodging and making their Nest in some Cavity, are there, by Heat and Rest, nourished till they bring forth Worms, either round⁴, broad⁵, or such as are called *Ascarides*⁶; or the same Insects themselves, being sometimes swallowed with the Food, are retained, and grow up in the Body. But these by sucking, moving, vellicating, gnawing or
boring

boiling ⁷ through the Membranes, *consume* ⁸ the Chyle, irritate the Nerves, wound the solid Parts, and create Sicknefs, *Shiverings* ⁹, Heart-burns, Vomiting, Faintings, *Leanness* ¹⁰, extreme Hunger, a Tumor of the *Abdomen* ¹¹, and the like; but, more especially, they create *Flatulencies* ¹², and sudden *Tumors* ¹³.

¹ Every Animal hitherto known, is generated by other Animals before existing; for *Redi* has demonstrated, in his excellent Experiments, that no Animal can be generated by Putrefaction, unless some Animal first lays an Ovum upon the putrid Body; nor does the most putrid Flesh generate Worms, when accurately shut up from Air. These Experiments were made by him in the Air of *Florence*, where Worms are formed from the Eggs of Flies upon Flesh in the Space of six Hours Time. No one has ever yet been able to produce an Experiment contrary to the Truth discovered by that *Italian* Naturalist, with respect to the Generation of Insects; and without Exception, all Animals throughout the whole Universe are generated from Eggs, and those too impregnated. But Generation in Animals is threefold; being performed sometimes by a Male and Female distinct, but coupled together. 2. Other Animals have both the Parts of Male and Female together, the male Part of one serving to impregnate the female Part of another of the same Kind, and the reverse; so that they all of them bring forth, as we see in Snails, but not without the Assistance of coupling with each other. 3. Other Animals again are both Male and Female in themselves,

capable of bringing forth their Young without the Assistance of another.

² Experience demonstrates, that the *Semina Papposa* of Plants, which are much larger and heavier than the *Ova* of Animals, are carried up in the Air to the very Tops of Towers, where they take Root, and grow up. I have also demonstrated, in treating upon Air in my Chemistry, that there are sometimes Clouds of Insects flying therein. Sir *Hans Sloane*, in his Voyage to *Jamaica*, saw Clouds of Grasshoppers flying over the immense Ocean which lies betwixt *Asia* and *America*. The Air is therefore no less stocked with Animals than the Waters are with Fish. A cloudy or rainy Air, especially in warm Countries, is full of small eating Animals, which soon after Rain, suddenly eat up one's Cloaths upon which the Rain fell. With the Air then, Insects may enter our Bodies, and there deposit their Eggs. In the *Indies* there are often Worms found, which insinuate through the Skin, and are under a Necessity of being extracted from the Surface; yet I would not have it believed, with *Kircher*, that the Cause of the Plague consists in the whole Atmosphere being filled with Insects, which infect our Blood, and there breed Worms, in which consists the Essence of the Plague, as he thinks: But this Hypothesis is repugnant to Experience. All I intend is, that the Rudiments of every Animal at any Time found in the human Body, was first derived from, or conveyed in with the Air.

³ Vinegar which is become vapid, or deprived of its Sourness, appears full of small Animals; and even Ale or Wine itself easily generate Worms; but Water more than any other Liquor abounds with Worms, and those more especially which are derived from Vegetables. *Lewenboeck* has demon-

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strated that all our Drinks exposed to the Air generate a Kind of small Animals which are truly Fish. Apples, Pears and Bread, are full of Animalcules; and even Butter or Cheese kept a long Time, always appear full of Worms. There was a lamentable Instance of a Girl at *Rotterdam*, whose six pituitary Sinuses were all full of Worms, which grew up and shewed themselves Hour after Hour; and this Girl I cured by a slight Fumigation, with Cinnabar and a Decoction of Tobacco in Water, which being snuffed up the Nose, obliged the Worms to quit their Residence.

⁴ These are white round Worms, and excepting their white Colour, resemble Earth-worms which are red. But even those Earth-worms being well cleansed and fed a while, by sprinkling them with warm Milk, do at length become white, as appears from Experiments; whence it seems to follow, that these round Worms are derived from the Ova of Earth-worms, taken in with our Food. No Worm was ever found in a Fœtus, during the time of its Residence in the Womb, nor even in Children so long as they are fed with Milk, or other Food which has been boiled; but they begin to be troubled with Worms when they feed upon crude Aliments.

⁵ We have many certain Instances of these broad Worms discharged to the length of several hundred Ells, which have filled the small Intestines in a convoluted Knot or Body, even from the Pylorus to the Colon. I have myself brought away three hundred Ells of this Worm from a *Russian*, only by the Use of Vitriolum Martis given in Honey.

⁶ The Ascarides reside only in the Rectum, where they often excite an intolerable itching before Sleep. These are the Worms, in a Manner

peculiar to the human Body, the other Kinds being more seldom met with.

⁷ There are several Instances of the Intestines eat through by Worms.

⁸ Hence it is, that People troubled with Worms are continually craving for Food, and are nevertheless lean, though they feed all Day long.

⁹ And this more especially, when they ascend into the Stomach itself; for then Infants are sure to be convulsed, and adult People are troubled with such a Nausea or Sickness, that they are reaching every Moment.

¹⁰ They cause Leanness by intercepting the Chyle, which supplies the Matter for Nutrition; and,

¹¹ A Swelling of the Abdomen is almost constantly observed in Children troubled with Worms.

¹² These Flatulencies are more especially observed sometimes in Camps, in which the Soldiers often swell as if they had taken Poison; and upon opening the Bodies of such as have perished in the Disorder, the Intestines are found full of Worms, which ascend in Heaps towards the new Chyle; and this is the Cause of the flatulent Swelling in the Intestines, since Flatus always follows Irritation.

¹³ Sudden Tumors arise, more especially after taking Food, when the Worms all hasten from the Intestines, to that Part where the Quantity of good Aliment lies. This is a most certain Sign of Worms. It is a frequent observation in many who have eat great Quantities of raw fruit, and drink foul Waters: and such was the Case in a Disease which invaded the Camp; for those who eat Food were swelled, and those who abstained fainted away, which caused a considerable Loss in the Army; and upon opening the Bodies to discover

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cover the unknown Cause of the Disorder, the Intestines appeared filled with Knots of Worms. Hence in all acute Diseases, when the Patient has Worms in his Bowels and does not eat, they creep into the Stomach, and sometimes out of the Mouth, which last is even a fatal Sign, and demonstrates that the Bile, Juice of the Pancreas and Stomach, are of so bad a Nature, that they are unfit to nourish the Worms, which is the Cause of those Animals taking their Flight.

§. 793. External or internal Violence from Bodies in Motion, hurt all the *mechanical*¹ Actions of the most simple Parts of the Body hitherto known; and their Effects therefore can neither be referred to Heat, Cold, Dryness, Moisture, any chemical Principle, nor corroding Acid or Alkali. In the same Manner we also observe, that there are other invisible Causes, of whose Action we may be easily *persuaded*² from their Effects, though their Matter being invisible may be very little known; and these may likewise produce Diseases, especially of the *similar*³ Parts.

¹ All Sects agree in this, as those Maladies depend upon the most simple Actions of Matter, and cannot be referred either to the chemical Principles, or to the four cardinal Qualities. Only Weight, Figure, and Motion, are the Instruments here employed; and yet this simple Action produces the same Effects upon the Body with Medicines, which are by every one esteemed to be efficacious Remedies. Hence it is manifest, that all Diseases can neither arise from Heat, Cold,
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Uc. not from Acid or Alkali, according to the Affirmation of *Sylvius*: for his Theory explains neither the Acrimony of Oil nor the Action of the Lancet. Whether a sharp-pointed Dagger of any Metal be thrust against the Body, or whether a sharp-pointed Piece of Wood, Stone or Bone be applied in the same Manner, the Effect will be always the same, a Wound and Extravasation of Blood.

² If in the human Body the invisible rigid Elements or small Particles unite together like a small Dart or Dagger, they may produce altogether the same mechanical Effects, that is to say, they may wound and destroy the Vessels; but the same elementary Particles, although combined in a sharp-pointed or edged Figure, will produce no Action after Death, any more than a Knife never injures its Sheath without it be moved by somebody.

³ There are many invisible Causes which act mechanically. *Lulli* gives it as his Opinion, that Mercury exceeds in the Simplicity and Divisibility of its Parts. I have myself tortured Mercury for the Space of twenty five Years together, to separate its two Principles, but have been able to effect nothing. But Mercury is thirteen Times heavier than Blood, and therefore it acts very powerfully upon the latter. A Bullet of Lead is perhaps 185 times heavier than another of Wax, and if they are both exploded with the same Force of Powder, the leaden Bullen will act with an hundred and eighty five Times greater Force than that of Wax, which from its Levity, continually loses both of its Motion and Force.

§. 794. The Matter of a Disease lodged in any Part, being suddenly collected together,
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is called an Afflux, but slowly collected, is termed ¹ a Gathering; the Cause whereof is an Inactivity of the Solids, neither attenuating nor expelling that which begins to be formed, namely, the offending Matter; or else a Derivation of the peccant Matter, from some other Part, to that which is now diseased.

¹ From hence arises that familiar Distinction of Tumors among Surgeons into those by Fluxion, and by Congestion; by the former, they understand a very sudden Appearance of the Disorder, as when a Calculus slips from the Pelvis of the Kidneys into the Ureter, and from thence into the Bladder; but a Collection is when the Matter is slowly gathered together in the obstructed Part.

§. 795. This Derivation, or as it is termed by the Ancients, Fluxion or *Attraction*¹, is occasioned by Motion, Heat, Pain, and Digestion of the Humours; and hence arise those Diseases which are said to be attended with Matter.

¹ Thus *Hippocrates* observes, that every Part of the Body much heated, moistened, rubbed, or in Pain, soon swells, as is easily experienced in the Arm, by applying any of the forementioned Causes, and then comparing the Arm with the other sound one which is not affected. At present, as we are acquainted with the Circulation of the Blood, we know that the Humours are derived to every Part in Proportion to their Bulk: But that when an Obstruction is formed in any Part, so as to make the Resistance greater there than in another Part, then the Humours are drove where
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there is the least Resistance ; hence wherever there is a Dilatation or Laxity of any Part, there will be a Fluxion, which therefore differs but little from an Obstruction.

§. 796. Poisons, the Plague, Contagion, and several Kinds of other Things taken into the Body (§. 744. N°. 1. and 4.) injure the Solids and Fluids, or both, in such a Manner, as to stop the vital Course of the Humours ; for they act always by mechanical Force (§. 793.) but they are very often not to be explained but by the Doctrine of *chemical*¹ Principles. They may be easily conceived to injure the Solids, by dissolving, relaxing, constringing, or obstructing them ; and they deprave the Fluids by rendering them too thick, too thin, or acrimonious ; and thus they corrupt both Solids and Fluids together by their conjunct Power : And therefore the Generality of these Causes act speedily upon the Lungs, Nerves, and Mass of Blood, in a Manner as yet but little understood or observed, which makes them esteemed extraordinary and *incomprehensible*² ; and hence it is likewise, that Diseases thus produced, were usually termed, by the Ancients, Disorders of the whole Substance of the Body injured.

¹ Such as the Doctrine of Acid and Alkali, which are Substances acting not only as Acid and Alkali in themselves, but as they are Opposites, and produce certain Changes in their Commixture with each other, different from the Effects of either of them alone.

² Chemistry is able to account for the Action of many Poisons; and it furnisheth with a Reason why Alcohol infused into the Veins of Animals, occasions sudden Death; namely, because it coagulates the Blood. From thence we are able to account for the Origin of malignant, contagious Fevers, which rage after People have fed much upon putrid Flesh in the Summer-time; namely, because the Salts of the Blood are changed into a volatile alkaline Nature. But all Causes act either upon the Solids or the Fluids, or on both. God has imparted to every particular Body its peculiar Qualities, which *Pythagoras* calls Monads: As for Instance, I am myself one, and every single Part of me, as a Finger, is also one Individual; but again, every Finger is composed of three Joints, each of which is distinct and different from the rest. Every Body therefore has its own individual and essential Principles. A Horse is produced from Grass; but then Grass is never changed into a Horse, but in the Body of that Animal. These essential Principles or Properties of individual Bodies, are not capable of being explained mechanically. Even the Hypotheses of those who have attempted to explain them, have hardly survived a Year. Yet those Things which result from the general Properties of Bodies, are nevertheless capable of a mechanical Explanation; as for Example, that the Powder of Diamonds is rank Poison, because it cuts, inflames, and destroys the Bowels, like small Lancets. But with respect to the primary Properties of Bodies, we can explain nothing; as for Instance, if you ask why Arsenick kills a Person by its deleterious Force, when it has no Effect upon a dead Body, the Chemists will endeavour to answer you, by saying, it is the Sulphur of the Arsenick; but this Explanation leaves

us in the same Darkneſs. It muſt be obſerved, that we are ſometimes not capable of giving a Reaſon for the Actions of Things, upon the Account of the Minuteness of their Particles; as when a Viper has bit a Perſon, all the Symptoms of an acute Fever follow, the Skin itſelf turns yellow in the Part of the Wound, and at length Death cloſes the Whole, notwithstanding the Aſſiſtance of Remedies. This is what we are not capable to explain, even though we were acquainted with the Nature of the viperine Poiſon. There was an Experiment made with a Viper at the Court of *Tuſcany*, by cauſing the ſame to bite the Noſe of a Bull, and the Bull expiring in a little Time. Being opened, there was no Appearance to be found of any Thing amiſs, either in the ſolid or fluid Parts. They, who have ſeen the Effect of the Poiſon of Toads, which is fatal to Mankind, and kills by exciting Anguiſh and Convulſions, have nevertheless not been able to find any Change in the dead Body, nor any Appearance in the Poiſon itſelf, which ſeem equal to the Effects. A Perſon who has breathed in the Vapours of fermenting Wine, will either drop down dead, or be invaded with ſome terrible Diſorder, of which we had an Inſtance in the celebrated Anatomist *Helvetius*; for by this means he lay ſeveral Days without Motion, and was afterwards afflicted with a Hemiplegia; and at length loſing his Memory, was in a Manner reduced to the State of a Plant. I believe no one can or will even pretend to explain theſe Phænomena.

§. 797. But there are ſome particular Cauſes of certain Diſeaſes, which ought well to be remarked, as they give Riſe to an ill Conformation

tion of Parts; and these are chiefly either from the Mother's Imagination, the imprudent Treatment of the *Midwife*¹ or *Nurse*², or at least from some Negligence in the Guardian; for by these Means the tender Body of the young Child being agitated, pressed, pulled, struck, bound, &c. acquires a deformed Shape, which can afterwards hardly be corrected. But the same Thing is also sometimes produced from the Disposition of thick and acrid *Humours*³.

¹ It is no uncommon Thing for these Women to deform the tender Heads and Bodies of Infants, which are soft and pliable like Wax, and no ways capable of supporting their rough Treatment. Hence it is, that we so frequently meet with Deformities of the Head, causing Foolishness, by its being pressed either into an oblong, angular, or other improper Figure, as Dr. *Willis*, and myself, have observed; and which has often made me think, Women might do better without any Midwives. For the Assistance of the Midwife is never required, but when the Birth is obstructed by some Means; whereas these Women wait not for the Time and Endeavours of Nature, but tear open the Membranes of the Birth, and extract the Infant before the true Pains or Throws of the Mother appear. I have often observed in these hasty Deliveries, that the Limbs of Children are dislocated or broke. When the Limb is dislocated, the Child continues miserable all its Life, because the Disorder is not known; and if it is broke, the Limb contracts from its natural Length, and the Child becomes a Cripple when grown up. In the infant State likewise, the Epiphyfes, or Heads

of the Bones are easily separated, whence many become lame, or halt, when the Head of the Femur has been thus separated. In a Hundred Bodies of lame People, *Du Verney* found the Cause of the Disorder to be a Fracture in the Neck of the Femur. I therefore advise you to make it a Part of your Practice to restrain the Rashness of Midwives, whenever an Opportunity shall offer.

² These Women frequently do great Injury to Girls, by making them sit leaning always to one Side, or with their Arms confined to one Posture, when at the same Time the Body ought to be changed into all Postures, and to be equally pressed on all Sides; but by these bad Habits, that Part grows less, which is most restrained or pressed, and the other growing more which is at Liberty, occasions a Deformity. From hence, very often, one Leg or Arm is weaker than another, and sometimes a Limb is rendered wholly paralytic. Very often, when a Child throws itself backward over the Arm of a Nurse, she suddenly catches hold of the Feet, and by that means pulls off the Head from the Body of the Femur; and while the Ligaments are yet lax, there arises a new Articulation betwixt the Head and Neck of the Femur, which causes the Infant to be lame ever after. It is also another bad Practice with some to swathe their Children with Rollers; whereas Nature suspended the Fœtus in the midst of a warm Liquor, that it might be equally pressed on all Sides; but now being unequally bound up from Head to Foot, their Bodies are liable to various Deformities, from the Pretensions of the Nurse to be wiser than Nature. In *Asia*, their Children are only covered with a loose Cloth, and yet we there find neither lame nor crooked People; but the

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Mother's Imagination very often adds to, or diminishes from, the Parts of the Body.

³ Thus great Deformity arises from a preceding Cacochymia, when Acrimony is joined with Viscidity; this is evident in the Rickets and venereal Disease, by which the Bones of People who are well born are distorted.

§. 798. The Causes also vitiating any Cavity in Parts which are deformed, whether internal or external, are likewise to be here referred (§. 707, 709.); but the Diæresis, or Division of Vessels, proceeds either from Distension, Acrimony, or some external Violence. From hence we may be able to understand the Disorders which are related to those before mentioned.

§. 799. A violent Pressure or Distraction may relax or break the Ligaments connecting the Limbs, so as to produce Luxations, *Distortions*¹, *Ruptures*², or a Prolapsus of various Parts.

¹ Distortions arise from the Muscles acting unequally.

² Which arise from a Relaxation or Distension of the Membranes, from a too violent internal Pressure.

§. 800. All Things which cut, prick or stab, beat or contuse, corrode, *burn*¹, distend or tear, are the principal Causes of Solution of Continuity in the solid Parts.

Fire is the universal Mover and Dissolver of all Bodies, by means of which, when concentrated by a Speculum, Glass, Metal, and even Stones, are reduced into a State of Fluidity; but in the much more tender human Body, it occasions lamentable Destruction in the sensible Parts. It volatilizes all Bodies, except Earth. A Hair of one's Head is burnt in a Moment in the Flame of Alcohol; yet does it retain its Figure and Cohesion of Parts, unless you pull them asunder; but so slight will this Cohesion be, that the Ashes may be separated into the Air by the least Blast; for nothing now remains but the earthy Part of the Hair. If you try the same Experiment with a Bit of Flesh, the oily Parts will be burnt in the same Manner, the aqueous and volatile Parts will all exhale and leave only the earthy; and yet will those earthy Parts retain their Figure, and resist the Action of the Fire without being consumed; but then the Cohesion of these Particles is so small, that the least Force makes them fall asunder from each other. As for the fabulous Account which the *Jewish* Rabbins give us of the Bone Luz, belonging to the Loins, which they tell us is the only one that remains uncorrupted, and by Virtue of which all the other Parts of the Body are to be attracted and joined together again; this is altogether a ridiculous Fable, raised to account for the Resurrection.



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